THE ECONOMIC IMPACTS OF ENERGY PRICE CHANGES ON THE ECONOMY OF OKLAHOMA: AN APPLICATION OF AN INTERREGIONAL INPUT-OUTPUT PRICE MODEL

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CHAPTER I

INTRODUCTION

Need for the Study

Energy prices have risen steadily since the 1973-74 Arab oil embargo. Between 1974 and 1981 the price of domestic crude oil at wellhead rose from $6.87 per barrel to $31.77. The average landed cost of imported crude petroleum rose from $6.26 per barrel in December 1973 to $35.85 in 1981. The price of motor gasoline in major U.S. cities rose from 53.2 cents per gallon to 131.1 cents for leaded regular between 1974 and 1981.

Between 1981 and 1982 petroleum product prices declined slightly due to an international oil glut and the inability of the OPEC member countries to reach an agreement on international oil prices. The domestic wellhead price of petroleum decreased from $31.77 per barrel in 1981 to $28.52 in 1982. Average landed import oil prices declined from $37.05 to $33.55. The price of motor gasoline decreased on the average from 135.3 cents per gallon to 128.1 cents for all types. Other energy prices also increased continuously. The average wellhead price of natural gas increased from 22 cents per thousand cubic feet in 1973 to $1.98 in 1981, and to $2.41 in 1982. Average retail prices of electricity increased from 1.96 cents per kilowatt-hour in 1973, to 5.46 cents in 1981, and 6.13 cents in 1982.

Higher energy prices affect the national economy in many directions. They lead to higher industrial prices, and affect investment, employment and government revenue. Agriculture is also affected by higher energy prices. Natural gas is allocated to the agricultural sector for purposes of irrigation, post-harvest drying and other farm uses. Gasoline is used for production, marketing of products and supplying of inputs. Rural communities and farm families require electricity, heating fuels and gasoline for job commuting and other family related transportation needs. Higher energy costs lead to lower farm outputs and higher food costs.

Higher energy prices contribute to higher income and employment in the energy-producing sector of the economy. Through the secondary economic effects, the increase in income and employment in the energy-producing sector leads to higher output, income and employment in other sectors of the economy. Energy producing regions show higher growth rates of income and employment than the rest of the country when energy prices rise. Through interregional feedback, these energy producing regions import more from other regions. Hence income and employment in some regions of the rest of the country could be induced to rise by an increase in energy prices.

The many economic consequences of higher energy prices have raised concerns of economists. Much work has been done on the aggregate economic effects of energy price escalations. Results of such work have been wide ranging, including the contributions of higher energy prices to national recessions (73), accounting for energy prices in current inflation (72), and the stimulus of higher energy prices to factor substitution (27). In the area of regional economics, Miernyk advanced the hypothesis that higher energy prices in the United States would result in income increasing more rapidly in regions (states) which produce energy than in regions which do not (69, 70, 71). Manuel tested Miernyk's hypothesis by using the export base model to explain per capita income growth (66). Lee, Blakeslee, and Butcher (59) applied an input-output methodology to study the impact of exogenous price changes of wheat, electricity, petroleum, and natural gas on the Washington State's economy. Polenske (86) developed the Multi-Regional Input-Output Model (MRIO) and studied the regional impacts of changes in regional energy costs.

Oklahoma is a major producer and consumer of energy. Any exogenous changes in prices or demands for energy affect the income and employment of this region greatly. In 1978 Oklahoma produced 2,939 trillion BTU of energy and consumed 1,483 trillion BTU, thus exporting about 49.9 percent of its 1978 production. On the other hand, Oklahoma production of energy decreased by 10.0 percent from 1970 to 1978 while consumption increased by 36.3 percent over the same period. In 1980, 76.3 thousand people were employed in the oil and gas extraction and refinery industry, whereas only 52.7 thousand people were engaged in the agricultural sector. The percentage of people employed in the oil-gas extraction and refinery industry increased from 5.5 percent in 1970 to 6.4 percent in 1980, while employment in the agricultural sector fell from 6.6 percent to 4.4 percent.

Exogenous increases of energy prices have great impacts on the economy of Oklahoma. Higher energy prices induce more oil and natural gas exploration and drilling. This means that more petroleum and natural gas will be produced in Oklahoma. Higher income and employment will be generated in the energy producing sector and in other related sectors of the economy as well. Higher incomes in the energy sector could induce more production in the agricultural sector. However, higher energy prices also lead to higher food costs in Oklahoma since energy is a major input in producing fertilizers and pumping irrigation water as well as marketing of farm products. Higher energy prices could induce more output and higher prices of manufactured commodities in an energy producing state. Higher energy prices may have further interrelationships with the utilization of water resources. More production of petroleum and natural gas require more water resources for drilling and refining. More kilowatts of electricity produced may demand more water resources for the generation of power in eastern Oklahoma. Higher energy prices may suggest new policies for factor utilization such as the use of coal rather than natural gas in the generation of electricity. Finally, higher energy prices nationally could induce some energy-favored industries to locate in Oklahoma since they would find it more profitable to locate nearer the source of energy inputs.

To trace the impacts of exogenous changes in energy prices on production, income, and employment, as well as on prices of agricultural products and other goods and services of Oklahoma and other regions of the country, on interregional input-ouput price model can be used. Such a model is well suited to this purpose. Relatively little work has been done in this area, especially for Oklahoma. Ghebremedhin (38) developed a comprehensive energy information system for Oklahoma for 1972 and integrated this information into a dynamic input-output and simulation model to evaluate alternative energy choices and to project economic variables such as employment, income, government revenues and expenditures and gross state product. However, the economic impacts of higher energy prices on regional prices, output, income and employment have not been investigated.

Objective of the Study

The overall objective of this study is to construct an interregional input-output model for Oklahoma and the Rest of the United States economies and use this model to analyze the economic impacts of energy price changes. More specifically the objectives are to:

1. Develop an interregional input-output model with 81 processing sectors from the benchmark national input-output table for the base year 1977 to establish the interregional linkages between Oklahoma and the Rest of U.S.
2. Construct a human resource account showing the allocation of household income and consumption expenditure and employment in Oklahoma and the Rest of U.S. by economic sector and integrate the data from this account into the interregional input-output model for measuring interregional output, income, and employment multipliers. Interregional input-output multipliers are calculated for both Type I when the household sector is treated outside the model and Type II when the household sector is treated endogenous in the model.
3. Construct an energy balance sheet for the base period 1977 showing production and consumption of energy by energy source and by economic sector and integrate this energy data

base into the interregional input-output model for purposes of evaluating impacts of energy price changes on the economies of Oklahoma and the Rest of U.S.

4. Develop an interregional input-output price model to project the impacts of energy price changes on other regional commodity prices. This model is applied first to a hypothetical 20 percent increase in price of each energy source and then total energy throughout the United States. Next, the model is applied to the actual real price increases of petroleum products and natural gas in Oklahoma and the Rest of U.S. between 1977 and 1981.

5. Develop a modified interregional input-output price model so that the final impacts of energy price changes on regional output, income and employment can be measured.

Organization of the Study

Chapter II presents a review of previous energy modeling. Chapter III describes the methodology of an input-output model in five parts, respectively: (1) a national input-output model; (2) a regional input-output model; (3) an interregional input-output model; (4) an interregional input-output price model, and (5) a modified interregional input-output price model. In Chapter IV, Oklahoma regional and interregional input-output models are developed and discussed. Chapter V presents the regional employment and income account. Chapter VI presents the regional and interregional energy account. Chapter VII presents regional and interregional multipliers. Chapter VIII presents empirical results of interregional input-output price models. Chapter IX presents empirical results of the modified interregional input-output price models in measuring the final impacts of energy price changes on regional output, income and employment. Chapter X presents the summary and conclusion. Appendices contain data sources and supplementary information.

CHAPTER II

REVIEW OF ENERGY MODELS

Introduction

The field of energy modeling is immense, new and rapidly developing. Virtually all the leading models were initiated soon after the Arab oil embargo in 1973 and are still under development. Energy models differ importantly in objectives, design and the maturity of their development. The models overlap in their economic content but differ in their detail and mode of organizing the supply and demand for energy. A discussion of all models is far beyond the scope of this review. In the first part of this review, the early energy models, which were developed before the energy crisis in 1973, will be discussed. In the later part of the report, the recent energy models are reviewed. In this section, energy models are classified in three groups--economy-wide energy models, energy sector models and regional energy models. Energy-price models which study the relationships between energy prices and other energy related variables are reviewed in another section. Finally, Oklahoma energy models are discussed in the last section.

Early Energy Models

For an indepth review of most of the major energy models and studies during the period 1960 through 1970, the reader is referred to the comprehensive study by Decision Science Corporation (62). More than 45 studies conducted in the United States were reviewed and supplemented with an analysis of energy models constructed in other countries, especially Canada, the United Kingdom, France, West Germany, Sweden and the Netherlands. These models were evaluated with respect to their capabilities in demand forecasting, supply forecasting, supply-demand interaction, effect of price on demand, effect of price on supply, regional breakdown, inclusion of policy issues and inclusion of technological change variables. One of the conclusions of this study was that although a large number of studies have been conducted in the area of energy supply and demand, most have concentrated either on the location of supply or demand and very few analyses were made in the area of supply, demand, pricing, and other factors which are needed to evaluate alternative policy issues. Another major finding was the lack of comprehensive and consistent analyses of price/demand and price/supply interactions. Additionally, it was determined that very few studies dealt with the problems at the regional level.

Energy modeling reviews have been made on electricity demand forecsting methods by the Federal Power Commission (26) and the Edison Electric Institute (10). Reviews of national energy studies and demand forecasts have been made by Battelle Memorial Institute (4), Edison Electric Institute (96) and the Committee on Interior and Insular Affairs of the U.S. Senate (16, 2). Jones (54) also reviews energy modeling in the early 1970's.

Energy modeling activity was on a very rapid growth curve in the early 1970's. During 1970-73, there were many major conferences concerned with energy modeling in the U.S. and many energy models were developed. Energy modeling efforts proceeded along quite diverse paths, using a wide variety of modeling techniques. The major directions of this effort can be characterized under three headings: static models, equilibrium models, and dynamic simulation models.

Static models are those which do not deal directly with changes in time. They are generally not used for predictive purposes but rather for studying energy system structure and operation. Equilibrium models, on the other hand, usually consider variables which change with time and are often used for predictive purposes. However, they consider the response of the system to inputs by assuming pseudo steady state conditions or consider only the net result after all transients have died out. Dynamic simulation models are able to consider transient responses, as well as steady state solutions. Dynamic simulation models are normally used for predictive purposes where transients are of prime importance.

Linear programming is the most commonly used modeling method for static energy models. Such models are primarily used to study the structure of energy systems and the various flows of energy and other associated materials. They are also well suited for optimization. The traditional form of an optimization model is with an objective function minimizing costs of meeting established demands for energy from known supplies. The geographic scale of the linear programming energy models is quite diverse. They range from a model centered around the energy system of New York City developed by the Brookhaven National

Laboratory and the State University of New York (51, 9), to the national energy model developed by the Atomic Energy Commission (3), and to the international energy model which considers both United States and Canada and developed by the Canadian National Energy Board (68).

The types of linear programming energy studies varies considerably, ranging from the electricity energy model developed at Battelle-Northwest (20) and Waverman's natural model (134) to the total-energy model developed by Battelle-Columbus and the Associated Universities (8). These models are large and complex, and require the specifying of a great many technical coefficients within the model structure. They generate output in terms of patterns of supply and cost for specific situations, given a stated product demand and supply availability by producing regions. They are most useful for generating alternative outcomes under changes in supply-demand assumptions. They present, in short, comparative static snapshots of alternative situations. Linear programming methods can also be combined with other modeling techniques as is done by Griffin (40). The Griffin model uses a standard econometric model to drive a linear programming model.

An alternative to linear programming is network analysis. Debanne (19), who uses this method to assess pollution control and new technology, claims network analysis can result in significant savings in computation time as compared to linear programming.

The energy "flow maps" which describe how the different forms of energy flow through an energy system can be considered another form of static energy modeling. These energy maps are widely used to show the relative magnitudes of various energy uses and to show the processes whereby energy resources are used to supply demands. These energy maps may consider only a certain region and may be quite detailed, as in the work done at the University of Wisconsin (30, 31). Similar energy maps are also useful for the development of some linear programming models. On the other hand, energy maps, such as the ones developed for the Joint Committee on Atomic Energy (97) may be very simple and consider the entire nation or even the world. These are usually used to give a quick overall perspective of the energy supplies and demands.

Input-output models are a common form of the equilibrium model widely used in economic studies. However, for energy studies, the models must be formulated on a unit of energy basis (BTU, KwH, etc.) rather than on a dollar basis. These models attempt to describe the effect of changes in the energy sector on the total economy and the effect of changes in the total economy on the energy sectors. Input-output models are well suited for showing both the direct and indirect energy cost of individual products. They are also useful for showing how different products contribute to total energy demand. The main drawback to widespread use of energy input-output models is that they are extremely data intensive and require the estimation of a large number of parameters and technical coefficients.

Herendeen (43) has converted the 1963 input-output tables to energy terms and has shown how they can be applied to a number of energy questions. The energy input-output coefficients for a number of years have been derived in work at Battelle-Northwest (87, 88). By determining the coefficients over time, the trends in energy use for various products can be seen. Almon (1) combines direct energy input-output coefficients with an economic model to forecast demand for petroleum. The energy model developed at Data Resources (133) integrates energy input-output models and economic models and allows price effects and substitutions between fuels to be considered.

Economic models are widely used for energy studies. Most often, these are equilibrium models. The areas of the energy system to which econometric models are applied are diverse as well as the particular methods used in individual models. This makes it somewhat difficult to address the advantages and disadvantages of the traditional econometric techniques. Exampls of the wide variety of problems for which econometric models are used range from Spann and Erickson's (96) assessment of joint costs in oil and gas exploration to the determination of substitution effects in energy demand by Erickson et al. (24). In some of the larger studies, econometric and economic models are being used as complementary models to, or driver for, other types of models. This was seen earlier in the Almon model (1), the Data Resources model (133), and the Griffin model (40).

Dynamic systems simulation (DSS) models consider the dynamic characteristics of a system or process under study. The theory behind using DSS for modeling industrial and economic systems was largely developed by Forrester (32). He later expanded the use of DSS to socio-economic systems as well (33, 34). A dynamic systems simulation approach takes into account the various interrelationships and feedback effects found in the system. The model is composed of several sub-models, each dealing with a certain area of the system. In a problem, the system would be given the initial conditions, parameters and variables. The simulation model then generates values of certain preselected variables. These values, in turn, are used for the next time span and the model is run again.

Due to its relatively recent introduction, compared to other techniques, DSS has not been extensively used in energy modeling. Also slowing its widespread use is the considerable amount of work, comparable to input-output and linear programming models, involved in developing detailed quantitative DSS models. MacAvoy and Pindyck (63, 64) have developed a simulation model of the natural gas industry of the United States using econometrically fitted parameters. This model shows the time path of development for scenarios of policy changes in the natural gas markets. It attempts to depict the dynamic structure and movement of the market place. Such models are highly useful for policy analysis, since a new policy can be entered into the models as a constraint or a parameter and the effect of the policy can be simulated against the base case. Baughman (5, 6) has developed a dynamic systems simulation model which simulates interfuel competition. His model considers the competition between the major fuels on a national basis. Both the demand and supply sides of the markets are considered simultaneously. Garret (35), on the other hand, uses a DSS model to simulate a single electric utility company. His model considers both capital investment and capacity expansion as a joint planning problem to obtain management strategies.

Recent Energy Models

The dramatic increase in world petroleum prices spurred more work on energy modeling. Many large-scale energy-economic models have been developed at the national and regional levels. The computer-based energy models are useful for long-range planning on various aspects of energy-related issues. Energy modeling techniques include optimizing linear programming, input-output, econometrics and dynamic system simulation.

Hughes (50) presents a very useful survey and taxomony of many of the important energy models in existence today. In his classification, these models can be viewed at four levels: macroeconomic growth, the interindustry composition of the economy, the interdependence of energy markets, and individual energy industries or markets. Whereas models at the first two levels analyze energy in relation to the economy as a whole, the third and fourth levels focus specifically on energy markets. Such models can be viewed as having a mix of levels (for example, macro-growth interindustry composition or individual energy industries or markets), and these levels are linked depending on the objectives of the model.

For the purpose of the following discussion, energy models will be grouped into three classes--economy-wide models, energy sector models and regional energy models. This classification is chosen in correspondence to that of Hughes. Economy-wide models are concerned with interactions between energy and the composition of the economy. Most of them are integrated macroeconomic and interindustry models. In contrast to the economy-wide models, which are explicitly concerned with interactions between energy and the economy, the energy sector models are mainly used for relatively detailed analysis of energy supply and demand for policy analysis, forecasting, or technology assessment. Interaction with the economy as a whole is rarely of interest. Regional energy models are concerned with the planning and policy of energy issues at the state and regional levels. Most regional energy models resemble the major national models.

Economy-wide Energy Models

Macroeconomic and interindustry energy models have three basic uses. The most common and basic use is to provide macro forecasts to "drive" an energy sector or industry model. The economy-wide models generate a consistent set of values for economic activity levels which affect demand for energy and factor prices for labor, capital and primary materials. Economy-wide models are sometimes used as self-contained systems to analyze economy-energy interactions at a highly aggregated level. For example, in the Energy Modeling Forum (23), economy-wide models are used to assess the impact of major energy developments on the long-term growth of the gross national product. Finally, economy-wide models are sometimes integrated (partially or fully) with energy sector or market models in a two-way linkage to take account of interactions between the economy and the energy sector in analyzing detailed impacts of major energy developments, such as an extended nuclear moratorium. In the two-way linkage, the energy-specific and economy-wide models are repeatedly iterated until mutually compatible values exist for all variables. Typically, the energy-specific model accepts activity levels and input prices from the economy-wide model and feeds back new energy supplies, demands, and prices to override the initial values of these variables in the economy-wide model. The process is repeated until comparable results are obtained.

Major energy-oriented model systems that incorproate macroeconomic growth include the Wharton energy model, the Long Term Interindustry Model (LITM), the Energy Technology Assessment (ETA) MACRO model, and PILOT model. All of these except ETA-MACRO employ interindustry models to analyze the composition of the economy in terms of the flow of goods, services and productive factors between industries and final demand.

The LITM and Wharton models employ "variable coefficient" specifications that relate overall economic-growth to the prices and activity levels of energy supplying and using industries. The other inter-industry models take no account of price effects, thereby tending to overstate the interindustry ramifications of contingent events. However, freedom from the requirement of having to estimate price effects from an entire economy permits the construction of fixed coefficient models in greater detail. In self-contained applications, fixed coefficient models with 100 or more sectors include some with few new technologies and are used to trace the interindustry consequences of major energy developments.

The Wharton Annual Energy Model (41, 42) was built by integrating the Wharton Annual Macroeconomic Model with an energy-oriented variable coefficient interindustry model having 59 intermediate goods and industries. Detailed energy-using sectors are well organized for use with detailed energy demand models. Post-Keynesian specification of the macroeconomic model is appropriate for intermediate-term forecasting and is of doubtful validity for long-range analysis involving substantial changes in the composition of the economy.

The Long Term Interindustry Model (LITM) or the Hudson-Jorgenson Model (48) is an integrated system of neoclassical macroeconomic growth and a 10-sector, energy-oriented interindustry model incorporating effects of prices and costs on supply and demand for energy, goods, and factors of production. The model analyzes the economy in terms of long-run equilibrium of supply and demand throughout the economy. Thus it is appropriately designated as an economy-wide integrating model for very long-range analyses but inappropriate for analyzing the intermediate-term effects such as a potential oil embargo.

The ETA-MACRO Model (4) integrates the Energy Technology Assessment (ETA) energy sector model with a compact neoclassical macro-economic growth model designed for long range assessment of interactions between energy and economic growth. Whereas LITM emphasizes long run equilibrium, MACRO explicitly incorporates lags in the adjustment of the economy's capital stock to changing prices of energy. ETA-MACRO also differs from the integrated macro and interindustry systems in that its macroeconomic model is linked directly with energy supply and demand in the ETA nonlinear-programming model of the energy sector. Compact structure expresses interaction between energy and the economy with a few parameters. The model is inexpensive to use and easy to interpret in analyzing broad features of energy policy, the economy, and technology. However, ETA-MACRO cannot be used to analyze the interactions between energy, the supply of productive factors, and the interindustry composition of the economy.

The PILOT Economic Energy Model (17, 18) is a dynamically specified linear-programming model of energy supply, designed for long-range assessment of new energy technologies and driven by a macroeconomic demand model. The original version, now undergoing substantial revision, features a 23-sector fixed coefficient interindustry model containing five energy supply industries, five energy-intense manufacturing industries, and three capital goods industries closely related to energy supply.

For analyzing broad economy-wide supply patterns associated with given final demands, the model is well specified, but the demand specification, which ignores price and treats consumption of each good as a linear function of total consumption, fails to capture the supply-demand interactions that are central to most analyses of energy and the economy.

The PILOT model is being modified to allow for use of flexible time intervals for simulation over a 100 year planning horizon. This feature permits model users to concentrate on relatively short-time intervals during the critical period of adjustment to a new technology or other development while economizing on computer runs by using long intervals for the less critical periods.

The Brookhaven-Illinois Input-Output Model (7), a detailed 110-sector interindustry model, employs devices of "energy products" to convert value coefficients of conventional models to physical energy measured in BTUs. The model is used as a linking device between the LITM interindustry formulation, organized in 10 economic sectors, and the detailed energy demand sectors of the Brookhaven Energy System Optimizing Model (15) and the Dynamic Energy System Optimizing Model (67).

Kim (57) has developed an interindustry energy model from the U.S. Department of Commerce's 1967 Input-Output tables to estimate: (a) the total (both direct and indirect) technical requirement of petroleum, (b) the extent of price increase due to an imposition of a tariff on the imported oil, and (c) the price elasticity of petroleum consumption for each of the 82 industrial sectors of the United States.

In this energy model, the conventional input-output model has been expanded in two directions: (1) changes in the imported prices are directly related to the final demands through price elasticities, and (2) changes in the final demands in turn affect the overall output and the employmnent level of the economy through the multiplier effects.

Energy Sector Models

Energy sector models are appropriate where the analyst is specifically interested in the interdependence of supply and demand for two or more energy forms and much less concerned with interaction between energy and the economy as a whole. Some of the leading energy sector models are the Brookhaven Optimizing Models, the Bulldog Model, the ETA Energy Sector Model, the Project Independence Evaluation System (PIES), and the SRI-Gulf Model.

Energy sector models employ a variety of architectures. The Project Independence Evaluation System (PIES) employs an integrating or market-clearing model to link specialized models of individual energy industries or markets. The Standard Research Institute (SRI)-Gulf model is a detailed integrated network of supply and demand functions organized in a modular structure. The Brookhaven optimizing models and many others employ a mathematical programming structure that selects the optimum linear combination of energy supply sources to meet energy demands.

The Brookhaven Energy System Optimizing Model (BESOM) (15) and the Dynamic Energy System Optimizing Model (DESOM) (67) are the leading examples of the sectorwide activity analysis approch, which has been employed in a number of energy models. In these models, the energy sector is treated as a simple complex of energy-supplying and using-activities for which the optimal (least cost) combination of supply sources is chosen to equate supply with demand. BESOM and DESOM, which have been employed extensively in long-range technology assessment and policy analysis by the Energy Resource and Development Administration (ERDA), draw upon the Brookhaven Reference Energy System, a detailed tracing of energy source use flows in physical (BTU) terms.

BESOM is a static equilibrium model. It minimizes the long-run annualized cost of supplying the end uses from the production processes and primary sources. DESOM is formulated dynamically. Capital outlays are separated from annual operating expenditures, and the model minimizes the present discounted value of these outlays and expenditures.

The Bulldog model has been developed by Nordhous (76) for long-range analysis of energy resource allocation alternatives. Bulldog employs an economic model of energy demand, divided into nonsubstitutable categories in which demand responds to energy prices and income. Macroeconomic variables are introduced exogenously. Energy supply is modeled as a linear program which is dynamic but specifies capital outlays as annualized flows. The model incorporates a sophisticated parameterization of technolgoical change and a well-organized articulation of the nuclear fuel cycle. However, like the other sectorwide activity analysis models, it optimizes on the basis of the average cost per BTU for large supply and end-use categories and, as a result, can produce accurate results only through the external imposition of constraints.

The ETA Energy Sector Model (65) is a nonlinear-programming model of energy supply and demand. ETA was used extensively in the analysis of nuclear and alternative technologies. ETA is highly aggregated, having only four electric and three nonelectric energy supply alternatives and only two categories of demand, electric and nonelectric. The demand specification of ETA, derived from the aggregated preference function of MACRO, directly incorporates own-price elasticities and cross-price effects in interfuel substitution. The supply specification is a conventional linear-programming process analysis in which the costs are specified explicitly in terms of investment outlays and current costs, as in DESOM. Primary fuel resources at different cost levels are cumulatively depleted. ETA's basic virtue is its compact structural expression of the energy sector in terms of a few parameters. When these parameters and exogenous variable values are calibrated against the results of more detailed models, the ETA or ETA - MACRO System ought to be a cost-effective device for broad assessment of major energy supply technology alternatives.

The Project Independence Evaluation System (PIES) of the Federal Energy Administration (25) is a system which can be used to produce forecasts of the state of energy markets and analyses of alternative energy issues. PIES consists of a number of interrelated models and data sets. The central component of the system is the PIES Integrating Model (PIESIM) which is a representation of the national energy system in which production, conversion, transportation, distribution, and consumption of energy take place. Inputs to PIESIM are generated by separate models of demand, oil and gas supply, coal supply, and refinery operation, each of which in turn requires inputs of data and assumptions. The separate demand and supply models typically produce specialized output reports which contain background information more detailed and extensive than that which PIESIM produces as its output.

The impacts of various energy market situations on the rest of the economy can be projected using a variety of models and methodologies. These models permit analysis of energy market impact on economic variables such as GNP, income, unemployment, household energy expenditures, and tax burdens. Inputs to the impact models include not only the PIESIM forecasts of the state of the energy market, but also additional inputs on investment, costs, and expenditures which are either contained in the original assumptions or can be extracted from the output of the preliminary demand and supply models which feed PIESIM.

The SRI-Gulf model (12) is a highly detailed, regionally articulated, and dynamic formulation of national energy supply and demand. Most applications of the model have been supply oriented, but its structure has general applicability to a wide range of microeconomic applications requiring detailed analysis of both demand and supply.

The energy sector is formulated as a network of competitive markets specified in terms of dynamic supply and demand functions for each market segment or process. A modification of the specification can allow for alternatives to the competitive specification. An innovative solution algorithm develops a consistent set of market-clearing prices for all market segments in each year and over time. The model has great generality and flexibility in selecting functional forms and in tailoring the degree of detail to particular applications. There is a sophisticated treatment of economic rent and resource depletion, an excellent detailed functional breakdown of energy--supplying and--using processes, and an ingenious demand specification for analyzing interfuel substitution. The model's modular network organization permits the user to tailor the degree of detail in any market segment to the requirement of the problem at hand.

Regional Energy Models

Energy models, particularly at the energy sector level, are valuable tools for planning and policy analysis at the state and regional levels. To date, the best models are national in scope, though some of them are regionally articulated. Models tailored to individual regions have usually borrowed heavily from approaches pioneered by the major national models. Recently, the Northwest Energy Policy Project employed an integrated system of energy models to analyze the energy future of the Pacific Northwest (13). A regional Brookhaven- type reference energy system was employed for supply and combined with estimated costs to develop supply functions. Demand was modeled econometrically using approches first developed in models estimated from cross-section data using states as observations. The integrating model employed the basic PIES concept in conjunction with techniques that assure a consistent equilibrium time path of prices.

The Wisconsin Regional Energy Model (WISE) (31) is being developed for the State of Wisconsin as a tool for quantitative long-range energy policy analysis. WISE is a dynamic simulation model, structured on a component basis to allow flexibility in: (1) focusing either on specific areas of the energy system, (2) modifying various parts of the model, and (3) adding to the model as additional policy questions arise. The model is intended to describe technological-economic-environmental interactions in the Wisconsin energy system over the medium to long range interval, typically considered to extend from three to 30 years. The model includes all forms of energy and treats demand, supply and environmental impact within both a physical and economic framework. The first version of the model is now operational and is currently being applied to the development of several total energy futures for Wisconsin through the year 2000.

The South Carolina Energy Model (46) is an integrated input-output model of the structure of the State of South Carolina economy and a detailed analysis of economic impacts associated with petroleum usage by the various economic sectors within the State. The location quotient procedure has been employed for simulating regional input-output matrices. A simulated input-output matrix of the South Carolina economy is in turn combined with a 15 times 56 matrix of petroleum usage coefficients to estimate the economic impacts directly and indirectly associated with various types of petroleum usage, i.e, employment, tax revenues, income and value added per unit of petroleum used for each of 56 economic sectors in the State so as to determine which sectors of the State economy achieve the greatest economic payoff per unit of petroleum used.

The Montana Energy and MHD Research and Development Institute (102) has forecasted demand for natural gas (including synthetic natural gas) in Montana. The purpose of this study is to determine the demand for synthetic natural gas in Montana through 2000 A. D. The approach used was to develop a model of Montana's economy on which energy demands can be used. A dynamic systems simulation approach was selected as most appropriate for the model. This approch takes into account the various interrelationships and feedback effects found in the Montana economy. The model is composed of several sub-models, each dealing with certain areas of the economy. The dynamic simulation is combined with input-output analysis in determining levels of economic activity. The industrial and commercial demands for energy are based upon the levels of activity in the corresponding sectors of the economy while residential demands are based upon the number of households and their income. In addition, the effects of inter-fuel competition and conservation are considered.

Wendling and Ballard (135) have employed a multiregional model developed at the Bureau of Economic Analysis to measure the regional economic and demographic effects of advanced U.S. coal production on the Montana economy. The model, National-Regional Impact Evaluation System (NRIES), is a medium-run (five to 10 year) impact analysis tool composed of 51 state econometric models integrated into a national framework. NRIES is a highly detailed model of economic and demographic interrelationships within the national economy. Within each of these state models, there are 264 equations, of which 68 are behavioral. There are, in addition, 20 behavioral and 100 total equations within the U.S. model. Thus, the full model system has about 3,500 behavioral and 14,000 total equations. The model includes a wide range of stochastically estimated economic variables for each of the 51 regions. Major economic categories include industrial output, employment, and wages (12 industries each); non-wage-income sources (four components);

state and local government revenues and expenditures (10 categories); personal tax and nontax payments (five categories); and retail sales (five outlet types). Demographic variables include births and deaths, population (five age cohorts), unemployment (total and insured), and labor force.

In the Montana Coal Model, NRIES is used to measure the economic and demographic impacts of two advanced coal development scenarios provided by the U.S. Department of Energy (DOE), Energy Informatrion Administration. In the first scenario, surface coal development in Montana has been increased, and a single-region application of NRIES is emphasized. In the second scenario, national coal development has been increased in what the DOE terms a medium-demand, medium-supply, high-oil-price scenario. Here, NRIES is used simultaneously in its regional, multiregional, and national capacities.

Goettle IV et al. (39) have proposed the formulation of alternative solution strategies for an integrated multi-regional energy and interindustry model of the United States. In their proposed formulation, the energy sector is represented in a detailed multi-regional linear programming model. This model optimally allocates regionally produced energy resources and selects the optimal regional mix of energy supply, conversion, and demand technologies according to least cost or other important criteria (e.g. an aggregate environmental index or foreign energy imports) to meet projected energy demands. Regions are linked by both imports and exports of natural resources and converted fuels or products, including electricity. Resources are characterized by region specific supply functions, and regional energy demands are specified in terms of functional end uses (e.g. space heat, air conditioning, process heat, and motive power).

The energy sector model is integrated with a multi-regional Leontief interindustry model of the economic system. Here, regions are linked not only by interregional energy flows but also by interregional industrial flows. Having specified the interindustry model in a multi-regional input-output framework, large energy-using industrial sectors can be removed from the interindustry structure and made exogenous components of regional final demand. These components can be driven by the results of independent comparative cost or econometric studies of industrial location. They may also be partially driven by intermediate solutions to the integrated model, operated in an iterative mode. The traditional components of final demand results from macroeconomic projections of regional product and its composition. These may be derived from a typical multi-regional econometric model.

This integrated multi-regional energy and interindustry model has overcome certain drawbacks of isolated use of either the energy optimization model or the interindustry model. While the I-O framework does allow for interfuel substitution, the nature or rate of technological change in the national/regional energy system cannot be internally determined. Further, the technological detail required for energy analyses is absent from its specification. Conversely, the energy model is weak in macroeconomic content. Supplemental information on Gross Regional Product and its components or on interindustry energy demand cannot be easily related to the specification of the demands which drive the energy model. The combination of the models reduces the a priori judgments that must be made prior to using either model, and the combined solution provides a more integrated and complete description of the national/regional-energy/economic system.

Energy Price Models

Early energy models relate the higher price in specific energy to the demand and supply of energy rather than to the impacts on the economy. Economists were concerned with how higher prices of energy would induce an increase in the production of domestic petroleum or natural gas and, at the same time, how it would discourage consumption of energy and encourage interfuel substitution. After the energy crisis in 1973-74, economists became more interested in the imapcts of energy price increases on the economy. Many energy models have been designed to measure the impacts of higher energy prices on income, employment, and factor substitution of the national economy as well as the regional economy.

Griffin (40) utilizes an econometric model of the U.S. electricity utility to simulate the effects of higher fuel prices on electricity demand and on the mix of fuel inputs to electricity generation. The model treats as an endogenous electricity demand, electricity prices, the efficiency of fuel conversion, and the choice among coal, natural gas, residential fuel oil, and nuclear fuel inputs. The results suggest that given projected fuel input prices, the short- and long-run impacts on electricity demand are likely to be small. The effect on fuel mix appears quite substantial in the intermediate and long run, but in the period of one year or less, fuel substitution possibilities appear fairly limited.

Pagoulatos et al. (83) developed an econometric model useful to examine the effects of selected price policies by the federal government on petroleum production. Attempt were made to determine if adjustments in the pricing mechanism for domestic crude oil will improve the demand-supply situation for oil in the U.S. Price policies examined include: (a) equalization of the domestic wellhead price of crude oil at the world price, (b) constant money wellhead prices for crude oil, (c) constant real wellhead prices with the 1976 world price with increases thereafter equal to the change in the domestic wholesale price index.

A theoretical model that captures the total system regulating the generation and extraction of crude oil is developed and estimated. The model is explicitly designed to test the responsiveness to price incentives of petroleum exploration, reserves generation and extraction. The model consists of three major components: (a) a petroleum exploration submodel, (b) a reserve generating submodel, and (c) a submodel generating oil for refined products. There are 11 stochastic equations and three identities in the model. They are estimated via three stage least squares and validated via a variety of numerical measures. The study indicates that rising crude oil prices provide the necessary incentive to the U.S. petroleum industry for intensifying the exploration effort. Higher price increases the number of new exploratory wells drilled and the use of secondary and teritiary recovery methods.

Pindyck (84) developed an econometric model of the natural gas industry to describe in detail the simultaneous behavior and interaction of natural gas and oil exploration and reserve accumulation, natural gas production out of reserves, natural gas distribution, and finally natural gas demand. The model is then used to forecast the regional effect on the industry of the higher prices proposed by the Federal Power Commission.

Hudson and Jorgenson (49) developed a dynamic general equilibrium model of the U.S. economy to analyze the effects of higher energy prices resulting from the establishment of the OPEC oil cartel in late 1973 and early 1974. The model is the Long Term Interindustry Transactions Model (LITM) previously mentioned (48). In this model production activity is divided among ten sectors: agriculture, construction, manufacturing, transportation, services, and six energy sectors. There are 13 inputs into each sector--intermediate inputs from the 10 producing and the three primary factors of production--capital services, labor services and imports. Each producing sector supplies output to each of the four categories of final demand: personal consumption, investment, government purchases and exports. The technology of each producing sector is represented by an econometric model giving the supply price of output as a function of the prices of primary and intermediate inputs and the level of technology. Also, technical coefficients giving the use of each type of primary and intermediate input per unit of output for each producing sector are derived as functions of prices and productivity. Consumer preferences are represented by an econometric model giving the allocation of personal consumption expenditures among goods and services as a function of prices and income. The level of output from each sector is determined given the final demands and the technical coefficients. Then, using the levels of output and the technical coefficients, each sector's demand for intermediate and primary inputs, including energy, is calculated.

In each period, the relative prices of all commodities are determined by the balance between demand and supply. Technical input coefficients are determined simultaneously with the prices. Final demands are also functions of these prices. Final demands and input coefficients together determine sectoral output levels and input purchases from the condition that there is balance between total demand and supply for each type of output. The condition that demands for capital and labor equal their supplies yields the prices of these primary inputs. The supply of capital in each period is fixed by past investment. Variations in demand for capital services affect the price but not the quantity of these services. Similarly, the supply of labor in each period is fixed by past demographic developments. Variations in demand for labor by the producing sectors and by the household sector for consumption in the form of leisure affect the price of labor and the allocation of time between market and nonmarket activities. Finally, the supply of savings by the household sector must be balanced by final demand for investment by the producing sectors. Dynamic adjustment to higher energy prices is modeled by tracing through the impact of investment on capacity expansion.

The dynamic general equilibrium model was used to simulate two economic growth paths over the 1972-76 period. In the first simulation, actual values of the exogenous variables, including world oil prices, were employed as the basis for model solution. This simulation provides an estimate of the actual development of the U.S. economy between 1972 and 1976. In the second simulation, 1972 energy prices were employed over the whole 1972-76 period; i.e. world oil prices were held at their 1972 real values. As world oil prices are the only set of exogenous variables to change between the two simulations, the differences in simulated economic activity can be attributed solely to the impact of the oil price increase. (Other energy prices are affected by the oil price change so all energy prices change between the simulations.) Therefore, comparison between the two simulations provides the basis for analyzing the impacts of the energy changes on energy use and on the level and structure of economic activity.

The overall conclusion of the study is that higher energy prices have had a dramatic impact on the U.S. economy over the period 1972-76. This impact is not limited to a reduction in the growth of energy consumption, but it has also resulted in a slowdown in economic growth, a weak recovery of capital spending, a substantial increase in employment as a result of increasing labor substitution for energy, and a decline in the growth of productivity.

Mork and Hall (72) attempt to quantify the economic impact on the U.S. economy of the 1974 oil price increases. They construct a medium-sized macroeconomic model of the United States with an explicit treatment of energy. The model treats the economy as having two sectors, goods and energy, but only the goods sector is fully represented. Energy is used as an input to the goods sector and is thought of as primary energy, such as crude oil, natural gas at the wellhead, and coal at the mine-mouth. A single price for energy is used and viewed as exogenous, and what cannot be supplied by the domestic energy sector is imported. The goods sector combines labor, capital, and energy to produce goods. The term "goods" covers all goods and services including finished energy products such as gasoline and electricity. Total goods production is allocated among consumption, investment in the goods sector, government expenditures, net export of goods, and deliveries to the energy sector. Within this sector the important features of the model are technology constraints with the three inputs of capital, labor, and energy; a money demand function with gross output as the transaction variable; a permanent income consumption function; rational expectations; and some important short-run rigidities, notibly in wage and price determination and in the investment process. The net result of the simulation of the 1973-74 energy price shock was clearly a major cause of the 1974-75 recession and inflation.

Miernyk (69, 70, 71) has analyzed the regional economic consequences of rising energy prices. He has compared the economic conditions of the energy-producing states with the nonenergy-producing states and concluded that as the relative price of energy continues to rise, there will be a shift in real income from energy-consuming to energy-producing states. Some of the economic rents which accrued to urban America will be returned to the coal and oil-producing areas. Profits earned by energy-producing companies may not remain in the producing regions, although as long as these sectors are expanding a significant share of these profits will be ploughed back into the expansion of capacity. Despite increasing mechanization, coal remains a labor-intensive economic activity with labor costs accounting for about 39 percent of total direct costs. Rising coal wages will boost personal income in coal-producing areas, and will have the usual income and multiplier effects. Some of the coal prosperity will rub off on other sectors in the regions involved. Although some regions will gain in income and employment at the expense of others as a result of rising energy prices, depressed coal-producing regions will not automatically be transformed into islands of prosperity. The benefits of high prices will not be widely diffused, although the extent of diffusion will depend upon the relative importance of energy production in each state. The high unemployment rates found in many coal regions during the nation's prosperous years should continue to decline. States with heavy dependence upon energy production should move up the per capita income ladder; other states will be displaced downward. The depressed areas of the next decade might well be concentrated in industrial states heavily dependent upon imported energy.

Manual (66) designed the export base model to test Miernyk's hypothesis that energy producing states experienced per capita income growth rates in post embargo years which exceeded those of energy consuming states. Indirectly, the export base model provided a confirmation of Miernyk's hypothesis. Energy producing and energy surplus states experienced considerably higher export base employment growth rates in the post embargo period than energy consuming and energy deficit states. Furthermore, of the two components of export base employment, mining and manufacturing, the former realized larger gains, particularly after energy prices accelerated and in the energy producing and energy surplus states. Through the export base mechanism, higher energy prices are likely to contribute to relatively rapid rates of income growth in these states generously endowed with energy resources. As yet, evidence is unavailable as to whether these income gains will be at the expense of energy dificit states.

Lee, Blakeslee, and Butcher (59) describe a method for incorporating exogenous price changes of wheat and energy into input-output analysis and thereby estimating the impact on a regional economy. The I-O model for price changes describe the relationship between a set of endogenous variables--sector outputs, factor purchases, consumption, imports, and income--and a set of exogenous variables--sector final demands, prices and autonomous income. The price set is broken into the price of goods and services produced within the region, import prices, and the wage rates. In the empirical work, though, they do not consider the effects of changes in the wage rate. The empirical results demonstrate that when the prices of wheat, electricity, petroleum, and natural gas are increased by exogenous forces, their effect on Washington State's economy are significant and diverse.

Polenske (85) has developed the multiregional input-output (MRIO) price model to study the differential regional impacts caused by changes in regional energy prices. The MRIO price model is a dual version of the MRIO model. It is an extension of the national price model that has been described by Leontief and others. For the price analysis of the interdependences among regions and industries, the national price model is reformulated into a multiregional form by incorporating a set of structural interregional trade coefficients. One version of the MRIO price model is used to show the variations from region to region in the dependencies among wages, profits, and prices, such as what effect a 20 or 30 percent increase in the wages of coal workers in Appalachia will have on the country. Other versions of the MRIO price model can be used to investigate policy issues that arise in periods of inflation. An area of particular interest is to isolate the price changes occuring in the energy industries and to tract the short run regional impact those price changes have on other industrial prices.

The final version of the MRIO price model is designed for the determination of the output and employment effect on a region-by-region basis.

Some preliminary runs of the truncated MRIO price model have been made using a 19 industry, nine region aggregation of data. Some results are observed from these preliminary calculations. First, changes in the price of a given commodity such as coal will have differential impacts on various industries. Because of the second, third, and higher round effects, the final impact cannot be easily determined without the use of an input-output table. Second, changes in the price of the commodity will also produce strong differential effects on the prices of the same industry in different regions, effects that can be measured through the use of the MRIO truncated model. Third, the effects represent only the effects on prices of other industries in the short run.

Oklahoma Energy Models

Being both a major producer and consumer of energy, rising energy prices greatly affect the economy of Oklahoma. The energy crisis of 1973 increased the awareness of energy-related issues within the state. However, not many energy models have yet been developed.

For complete studies of the energy system in Oklahoma, the reader is referred to the Final Report of Oklahoma Energy Advisory Council (79). This report presents the findings of 16 working committees which were created to evaluate and project Oklahoma's energy supply and demand requirements through 1990. Besides the projections of supply and demand requirements of all types of energy in Oklahoma, the report also contains findings on the relationships between available energy supplies in Oklahoma and the State's potential economic growth. The environmental impact of producing and consuming energy in Oklahoma has also been analyzed in this report.

Flood, Chang, and Schreiner (28) developed an input-output model of Oklahoma for estimating state energy requirements to 1980 and quantified some of the relationships among state's output, employment and energy use. Given the 20 sector input-output model of Oklahoma and direct energy coefficients by industry, they have generated: (a) the direct and indirect energy coefficient and (b) the direct, indirect, and induced energy coefficient for each sector. These two coefficients are used to project energy consumption by sector in Oklahoma in 1970 and 1980. With given employment-output ratios, they estimate: (a) the direct energy employment coefficients, expressing the relationship between employment and energy, and (b) the total energy required per basic job in the State.

Rychel (92) has designed an optimization model to evaluate the effect of energy prices and availability on food production in Oklahoma. For a predicted price and availability of variable inputs, the study optimally allocates these inputs to maximize the growers' profits and simulates the effect of this allocation on food prices, demand, and energy consumption. His study also investigates possible future energy situations and their effect as well as investigating alternate methods and policies for food production.

Jones et al. (55) has designed a dynamic simulation model of the electric utility industry of Oklahoma to study the behavior of the energy system of the region. The model considers two forms of energy--primary energy resources and electrical energy. The model is divided into three parts--energy resources, electric utilities, and the economy. The simulation model takes account for all of the complex interactions and feedback loops in the energy system.

The Oklahoma State University Second Century Project (103) has developed a prototype computer simulation model of the State of Oklahoma as a vehicle for quantitatively examining Oklahoma's future. The model projects future population, economic, and resource usage trends through the year 2000. The model uses two sets of inputs: (1) U.S. and World scenarios regarding economic conditions, fuel prices, migration patterns, etc., and (2) decisions, policies, laws and regulations made by Oklahoma decision makers, both in the private sector and in government. The computer model then processes these inputs through a set of equations which represents cause-effect relationships between the many interacting components of the model. (For example, some of the equations relate state tax revenue to both the amount and price of oil and gas produced, while other equations relate population growth to overall economic activities within the state.) The output of the model consists of projections for such variables as population, energy costs, tax revenues, per capita income and a variety of others.

Ghebremedhin and Salkin (36) have analyzed the potential economic impact of expansion in Oklahoma's coal industry. An economic base model is used to derive economic base multipliers. The economic base analysis has shown that expansion in Oklahoma's coal industry has the potential to create growth in eastern Oklahoma communities. Each 10 percent increase in coal mining employment is expected to provide for 340 new area jobs and help support an additional 1,100 persons in the area. The incomes and increased tax revenue gained from these people represent a potential benefit in the region.

Ghebremedhin and Schreiner (38) have developed a comprehensive energy information system for Oklahoma and integrate this information into a dynamic simulation model for purposes of evaluating alternative energy choices. The major contribution of the information system is its estimated distribution of energy utilization by input-output sector and basic energy source, thus recasting energy statistics into a form consistent with economic models composed of processing and final demand sectors. Energy sources are classified as natural gas, petroleum products, coal and electricity. The input-output sector classification consists of five final demand sectors and 81 processing sectors of which 77 are "demand determined" non-energy sectors and four are "supply-determined" energy sectors. The purpose of the model is to simulate the Oklahoma economy from 1972 to 2000 determining baseline data such as sector output, employment, income, value added, gross state product, government revenues and expenditures and energy use and trade. Impact analyses then comapre alternative growth rates in energy production and efficiencies in energy utilization with baseline projections.

Olson (82) has utilized a 16-sector Oklahoma State Input-Output Model (OSIM) to estimate the effect of rising energy prices on the Oklahoma economy. The first step of the model was the determination of the change in the value of production resulting from a change in energy prices, where the change in value of production refers to the increase in value of output in the mining (crude oil and natural gas) sector. Given the change in the value of mining output the next task was to determine the proportion of output likely to be delivered directly to final demand, or indirectly to final demand via foreward linkages.

After the changes in final demand were determined, the next step was to estimate the resulting change in gross output. The gross output multipliers were derived from the Oklahoma State Input-Output Model (OSIM), a non-survey model based upon the RIMS II methodology recently developed at the Bureau of Economic Analysis. OSIM employs the 1972 BEA U.S. input-output table and BEA regional earnings data for 1979 to derive a comparably-sectored Oklahoma model. Changes in gross output were converted into changes in value-added to eliminate double counting. This was accomplished with the use of value added-to-gross output ratios by industry at the state level. The next step was to determine the various shares of value-added employee compensation, profit-type income, net interest, rental income, and indirect business taxes. Changes in earnings were derived using earnings multipliers from OSIM. Finally, projections of average annual wages (in 1979 dollars) per worker were applied to earnings projections to determine the changes in employment resulting from a change in the value of production.

The application of the model to study the impacts of rising energy prices attributable to changes initiated in the primary energy sector concludes that if the Oklahoma economy were to experience a shift from the low to the high-price scenario, there would be a positive impact throughout the entire period, appearing either as a larger gain (1981-85) or as a smaller loss (1981-90). Measured in terms of employment, there would be a gain of 3,343 to 15,782 workers during 1981-85 as a result of switching from the low to the high price scenario, and a gain of 2,078 to 7,694 workers during 1986-90. Given the benchmark projections of total earnings and employment in Oklahoma for 1985 and 1990, while the impact of rising energy prices would be positive as a result of their effect on the primary energy sector, they would have a small impact relative to the total state economy.

Turner (105) broadly examined some of the general equilibrium effects of energy price changes brought about by the oil embargo and the subsequent run up in oil prices on the Oklahoma economy. He found that the direct income effect of a $1 rise in the price of oil and its natural gas equivalent at the 1979 production level is $479,489,170 per year. The wealth represented by Oklahoma's probable total reserves was calculated to be $122,644,170,000. If natural gas were immediately decontrolled, this wealth would rise by about $13,609,000,000. A $1 rise in the expected inflation adjusted price of oil and its equivalent in natural gas, would raise Oklahoma's energy wealth by $4,663,000,000.

He also found that production changes in energy have been delayed by price controls, but seem to be moving upward. Energy consumption per constant dollar of income has fallen 12.5 percent in Oklahoma. Changes in factor-demand in Oklahoma has increased employment by more than the national average, encouraged migration into the state, kept unemployment low and raised Oklahoma wages relative to U.S. wages. The overall effect of price changes on Oklahoma consumption and production was not undertaken, but it was clear that Oklahoma's output of energy related equipment had expanded. Both Oklahoma's total exports and total imports have increased over the 1972 to 1978 period.

The Oklahoma State Econometric Model (OSEM) developed and operated by the Office of Business and Economic Research in the College of Business Administration of Oklahoma State University has been used to forecast the state economic activity annually. OSEM contains 122 equations and over 200 total variables. The energy sector, currently in a rudimentary form, includes 21 equations of both consumption and production (53). The consumption side contains equations for residential, commercial, and industrial sales and average prices of electricity and natural gas. Additionally, the consumption of gasoline and distillates, kerosene, and residual fuel oils has been modeled. On the production side, the estimates have been made on the production of oil and natural gas. The forecasts of the OSEM has been published annually in the Oklahoma Economic Outlook (77).

Hiebsch (44) has updated and modified the Oklahoma Energy Advisory Council's publication, Energy in Oklahoma: Final Report of the Oklahoma Advisory Council. An econometric model of energy consumption with 54 multiple regression equations and 12 identities has been utilized. This model predicts and forecasts consumption of energy by type of energy and by user to the year 2000. It is divided into seven major energy users: residential, commercial, industrial, government, transportation, agriculture, and electrical utilities. Each major user's total energy consumed and the consumption of each particular energy source has been estimated. The types of energy modeled are electricity, natural gas, coal, liquified petroleum gas (LPG), residual oil, distillate oil including diesel fuel and kerosene, jet fuel, and gasoline. Hydropower and nuclear power were included with electric utilities consumption but these power sources were not modeled. Other categories modeled were LPG consumption by internal combustion engines and other uses of LPG; natural gas consumption for lease and plant uses and for pipeline use; and, under the transportation sector, consumption of energy by automobiles, motorcycles, trucks, buses, railroads, airplane, and barge usage.

This study found that income, population and past consuming habits were the primary determinants of residential consumption of energy inOklahoma. For the commercial user of energy, measures of output or economic activity and past consumption levels were the primary predictors of present energy consumption. The same is used for industrial customers. For both commercial and industrial customers prices or relative prices were found to be important, even primary in certain cases. For electrical utilities, consumption of energy was a derived demand, caused by the consumption of electricity. Electricity consumption was primarily determined by the economic well being of the state as mesured by increases in real personal income.

The primary determinants of transportation's energy consumption were oriented toward economic activities such as gross state product, industrial output for the state, personal income level, and tonage shipped. Also demographic variables such as population and the number with drivers licenses had a major impact. Previous consumption patterns again proved to be a primary determinant. In agriculture, the amount of farm activity such as acreage of winter wheat, and real output levels, was important. Relative prices were more important than for some previous categories.

However, the best determinants of total usage of a particular energy type were dominated by variables such as Gross State product and the previous level of consumption.

Distinct Aspect of This Study

The present study differs from other energy models in several aspects. First, this study attempts to construct an interregional input-output model to show interindustry linkages between Oklahoma and rest of U.S. economies. Second, the interregional input-output multipliers are measured to determine the impacts of any changes of final demand on regional output, income, and employment. Third, the interregional input-output model is used to project the impacts of energy price changes on regional commodity prices. Finally, impacts of commodity price changes on interregional input-output coefficients are measured so that final impacts of energy price changes on regional output, income and employment can be predicted.

CHAPTER III

THEORETICAL ASPECTS OF INPUT-OUTPUT MODELS

The purpose of this chapter is to discuss the methodology of input-output models used in this study. This chapter discusses the theory and assumptions of input-output models as they relate to the objectives of this study. The input-output models are described in three groups: (1) national input-output models, (2) regional input-output models, and (3) interregional input-output models. This chapter also discusses application of input-output models in (1) economic impact analysis which is highly useful for rural resource development planning and (2) price analysis particularly as related to energy price changes.

National Input-Output Models

Input-output analysis (or interindustry analysis) is concerned with the interdependence among economic sectors. The input-output model as used today is based mainly upon work completed by Professor Wassily Leontief (60). In the 1930's, Leontief developed a general theory of production based on the idea of economic interdependence, gave his theory empirical content and developed the first input-output table for the U.S. economy. His first book on input-output economics, <u>The Structure of the American Economy, 1919-1929</u>, was published in 1941. Since Leontief's work, input-output analysis has been extensively utilized as a means of investigating structural interrelationships among industries and projecting the level of change in the economy under a given condition of autonomous change in final demands.

The United States Bureau of Economic Analysis (USBEA) has subsequently initiated a policy to complete a U.S. input-output study every five years. The latest report of the Bureau on the U.S. input-output tables, The Summary Input-Output Tables of the U.S. Economy, 1973, 1974 and 1975 (110), presents summary (85 industry/commodity) input-output tables of the U.S. economy for the 1973-75 period. These tables were obtained by updating U.S. BEA's benchmark input-output table for 1972 (108).

Basic Components of Input-Output Models

All input-output models consist of three fundamental components: a transaction or flow table, a table of direct coefficients or technical coefficients, and a table of interdependence, or direct and indirect coefficients. These three tables with their mathematical manipulation will be discussed accordingly. A hypothetical input-output table developed by Jones (56) will be used as an illustration of the model.

The Flow Table

The first step in I-O analysis is to develop a flow table. This table is the essence of I-O analysis since it is an empirical model of the economy under study. It is the base of the model as the direct, and direct and indirect coefficients are derived from it. The flow table records total transactions occurring in a given economy during a given time period, showing final demand for goods and services and the interindustry transactions required to satisfy this demand. To develop a flow table, economic activities in the area under study are divided into functionally homogeneous groups called sectors and industries.

To illustrate the flow table, consider a model having four producing sectors and three final demand sectors. Each producing sector has a certain amount of output, which is used within the sector, purchased by other sectors, or purchased for final demand by the consumer. Table I presents the flow table of the model.

Entries in the I-O flow table are arranged in rows and columns. Rows represent sales and columns represent purchases. The table is made up of four sections called quadrants.

Quadrant I (final demand) contains all exogenous sectors of the model and is made up mostly of household expenditures, exports, capital expenditures, and government purchases. This is the autonomous sector which determines the level of output of the economy under study. Entries in Quadrant I represent the value of output purchased from the processing sectors. Changes in final demand are transmitted throughout the rest of the flow table.

Quadrant II (processing sector) contains those sectors (or industries) producing goods and services for final demand. These are the endogenous sectors of the model. All output of the processing sectors is either sold to final demand or to other processing sectors.

TABLE I

INPUT-OUTPUT FLOW TABLE

	Outputs to[1] / Inputs from[2]	A	B	C	D	Households	Government	Exports and Other	Total Final Demand	Total Gross Output
		Quadrant II				Quadrant I				
Producing Industries (Sellers) — Processing Sector	Industry A	10	20	10	5	10	5	10	25	70
	Industry B	12	4	6	5	10	3	5	18	45
	Industry C	3	6	4	10	17	10	3	30	53
	Industry D	10	5	10	5	2	5	23	30	60
		Quadrant III				Quadrant IV				
Payment Sector (Value added)	Households	15	4	10	10	1	6	0	7	46
	Other primary inputs	20	6	13	25	11	3	2	16	80
	Total Value Added	35	10	23	35	12	9	2	23	126
	Total Gross Outlay	70	45	53	60	51	32	43	126	354

[1]Reading across a row, sales to sectors along the top of the table by those listed in each row at the left.

[2]Reading down a column, purchases from sectors at the left of the table by sectors at the top of each column.

The processing sectors must comprise a square matrix (there must be as many rows as there are columns). The corresponding row and column totals for each sector (or industry) in Quadrant II must be equal. In most empirical input-output studies, this portion of the flow table is greatly expanded and often contains numerous sectors.

Quadrant III (payment sectors) accounts for primary and exogenous inputs purchased by the processing sectors. It shows purchases by processing sectors for inputs they do not produce. Entries in Quadrant III include payments to households in the form of wages, salaries, rental income, interest income and profits; payments to government; imports of goods and services; inventory depletion; and capital consumption or depreciation.

Quadrant IV shows the direct transactions between the exogenous and primary input sectors (payments sectors) and the final demand sectors. This includes outputs of the local economy as well as imports that enter directly into final use without any intermediate processing by the endogenous sectors (for example, services of household employees, local labor commuting out of the area for work, intergovernment transfers, direct household purchases of nonlocal goods, etc.).

The inputs and outputs of sectors in the I-O model are of two kinds: <u>intermediate</u> and <u>final</u> in the case of output, and <u>intermediate</u> and <u>primary</u> in the case of inputs. Intermediate output is that output sold to other processing sectors to produce other goods and services. Final output is that output sold to final demand and does not re-enter the production processes. Intermediate inputs are those which processing sectors purchase from other processing sectors (or industries). Primary inputs are distinguished from intermediate inputs in that they are directly employed by the using industry and their value constitute the value added by that industry.

Value added is included in Quadrant III and IV (the payment sector) of an I-O flow table, and is comprised of wages, salaries, rent, interest, profit or loss, business taxes and depreciation. Final demand (Quadrant I) consists of personal consumption, fixed capital formation, inventory accumulation, government purchases, and exports. The sum of final demand is equal to total value added plus imports by the economy (the total value of all rows in the payments sector must equal the total value of all columns in the final demand sector of the I-O model).

The interdependence of industries in the processing sector is the main concern of the I-O analyst. Each industry produces a certain amount of output or provides a certain service which may be used within the industry itself, sold to other processing industries as inputs, or sold to final demand. To produce its output, an industry may purchase inputs from itself, from other processing industries, and from primary and exogenous input sectors.

Each element in a row represents total sales by the industry named at the beginning of the row to the industry or sector listed at the head of the column. Conversely, each element in a column represents total purchases by the industry or sector named at the head of the column from the industry listed at the beginning of the row. For example, industry A (Table I) produced 70 units of output; 10 were used by A itself, 20 sold to industry B, 10 to C, 5 to D and 25 to final demand. To produce these 70 units of output, industry A purchased 10 units of its own output, 12 units from industry B, 3 from C, 10 from D, and 35 from payments. These purchases and sales of industries in the processing sector are used in computing the technical and interdependence coefficient tables.

(Tech. coefficients)

<u>Direct Coefficients</u>. The direct coefficients, developed from the data in the flow table, relate inputs of an industry to its total output. The direct coefficients indicate the input requirements per dollar of output for a given sector. Direct coefficients (sometimes called technical coefficients) are relevant only for the processing sectors; therefore, technical coefficients are computed only for the columns of the purchasing sectors. Calculation of the technical coefficients involves dividing all entries (purchases) in each industry's column by the gross output (total sales) for that industry. Therefore, the table of technical coefficients, arranged on the order of the processing sectors of the flow table, consists of the ratios of industry purchases of total output, arranged in rows and columns. Each column shows the inputs that the industry named at the top of that column required from each of the industries named at the beginning of the rows to produce a dollar of its output.

Direct and Indirect Coefficients. Direct coefficients show only direct purchases made by a given industry from all other industries for each dollar's worth of current output. This, however, does not account for the total change in output resulting from a change in sales (an increase or decrease) to final demand. An increase in final demand for goods and services of an industry within the processing sector will lead to both direct and indirect increases in the output of all industries in the processing sector. For instance, assume an increase in final demand for the products of industry A (Table I). Industry A, as it expands production to meet this new demand, must increase its purchases of inputs from supporting industries, B, C, and D. These are direct purchases.

However, as A increases its purchases from industries B, C, and D, they must also increase their purchases of inputs from other industries in order to expand their output to satisfy A's need. If there are other industries in the processing sector, their sales and purchases may also increase, depending upon their linkage to industry A and its supporting industries. These interactions represent indirect purchases and sales or indirect effects and spread throughout the processing sector (as well as into the payments input sector outside the processing sector).

I-O coefficients which measure both direct and indirect effects of changes in final demand are called interdependence coefficients or direct and indirect coefficients. They are computed from the table of technical coefficients through a matrix inversion process. The table of interdependence coefficients or inverse matrix shows total expansion of output in all industries as a result of the delivery of a dollar's worth of output to final demand by each industry in the processing sector. The table format follows that of the technical coefficients table. Entries are arranged in rows and columns representing each industry in the processing sector. Each column shows the output required both directly and indirectly from the industry named at the left (beginning of each row) for each dollar of deliveries to final demand by the industry named at the head of the column (top of table).

Table II exhibits the direct coefficients for the processing sector (Quadrant II, Table I). These were obtained by dividing each entry in columns A, B, C, and D by the column totals 70, 45, 53, and 60, respectively. This matrix of direct coefficients was subtracted from an identity matrix of equal size to obtain the Leontief I-O matrix (also called the [I-A] matrix). The Leontief I-O matrix was then inverted to obtain the inverse matrix (Table III). The sum of each column of entries in Table III yields the industry output multiplier. In this numerical example, the output multipliers (rounded to two decimal places) for industries A, B, C, and D are 2.14, 2.71, 2.25, and 1.94, respectively.

Assumptions of the Input-Output Model

The input-output model is based upon two fundamental assumptions. The most restrictive assumption is that the direct coefficients are

TABLE II

I-O DIRECT COEFFICIENTS

Industry	A	B	C	D
A	.1429	.4444	.1887	.0833
B	.1714	.0889	.1132	.0833
C	.0429	.1333	.0755	.1667
D	.1429	.1111	.1887	.0833
Households	.2143	.0889	.1887	.1667
Other Primary Inputs	.2856	.1334	.2452	.4167
Total Value Added	.4999	.2223	.4339	.5834
Total	1.0000	1.0000	1.0000	1.0000

TABLE III

DIRECT AND INDIRECT COEFFICIENT MATRIX
OR I-A INVERSE MATRIX

Industry	A	B	C	D
A	1.3894	.7749	.4348	.2757
B	.3076	1.3098	.2629	.1948
C	.1606	.2858	1.2023	.2592
D	.2869	.3384	.3471	1.2108
Total[1]	2.1445	2.7089	2.2471	1.9405

[1]Column totals are industry output multipliers.

fixed. The assumption of fixed coefficients implies that technology remains constant, no external economies or diseconomies exist, and no substitution occurs to changes in relative prices or availability of new materials (21).

The fixed coefficient assumption places limits on the use of the input-output model as a long-range forecasting technique. Empirical studies on the reasonableness of this assumption found that the fixed coefficient assumption is realistic for the short run; however; continued technological change causes the actual relationships to change over time. Therefore, periodical adjustments of the coefficients or the construction of a new table is suggested (14).

Another limiting assumption of the basic input-output model is that there are no errors of aggregation in combining industries into sectors. Industries within a sector are homogeneous and different from industries in other sectors. This implies that a given product is supplied by only one sector and there are no joint products. So the coefficients for a sector are representative of all the industries within that sector. Conclusions drawn from the analysis indicate the average conditions of the industries within the sector. The more sectors included in the model, the less chance that errors of aggregation will arise.

Mathematical Formulation of the Input-Output Model

A simple mathematical formulation of the flow table and coefficients tables can be presented as follows:

1. The Flow Table: This table defines the interrelationships which exist in an economy during a given time period and can be expressed mathematically.

The row total for a given sector, X_i, represents the total output for the sector, i.e. the sum of sales to processing sectors, X_{ij}, plus the sum of sales to final demand sectors, Y_i. It follows that:

$$X_i = \sum_{j=1}^{n} X_{ij} + Y_i \qquad (3.1)$$

The column total for a given sector, X_j, represents the total outlay for a sector; i.e. the sum of purchases from the processing sectors, X_{ij}, plus the sum of payments to primary sectors designated as V_j.

This relationship can be stated as:

$$X_j = \sum_{i=1}^{n} X_{ij} + V_j \qquad (3.2)$$

Total output must equal total outlay for each processing sector as the receipts from sales must equal receipts paid out for goods and services plus value of final payments to primary inputs.

This relationship can be shown as

$$X_i = X_j \qquad (3.3)$$

where

X_i = the total output, in dollars, of industry i during the base period.

X_j = the total outlay, in dollars, of industry j during the base period.

X_{ij} = total sales, in dollars, of industry i to industry j during the base period.

Y_i = amount of final demand, in dollars, for industry i.

V_j = total value added, or sum of payment to primary inputs, in dollars, of industry j.

i and j = rows and columns, respectively, of the flow table.

n = number of rows and columns, or size of matrix.

2. Direct Coefficients: Derivation of these coefficients assumes a linear relationship between purchases of an endogenous sector and the level of output of that sector. The equation for calculating these coefficients is:

$$a_{ij} = \frac{X_{ij}}{X_j} \tag{3.4}$$

which equals the amount of industry i's output necessary to produce one unit of industry j's output.

Direct coefficients are computed as indicated above for each industry in the processing sector. These computations yield the following matrix of direct coefficients:

$$A = \begin{bmatrix} a_{11} & a_{12} \cdots\cdots & a_{1n} \\ a_{21} & a_{22} \cdots\cdots & a_{2n} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ a_{n1} & a_{n2} \cdots\cdots & a_{nn} \end{bmatrix}$$

where there are n processing sectors, and A represents the complete matrix of direct coefficients.

3. Direct and Indirect Coefficients: Calculation of these coefficients yields a table of direct and indirect requirements per dollar of final demand. They are obtained by subtracting the matrix of direct coefficients from an identity matrix of the same order to

get the Leontief matrix, (I-A), and then inverting this matrix. The resulting matrix, $(I-A)^{-1}$, is the table of direct and indirect coefficients which may be expressed as follows:

$$(I-A)^{-1} = \begin{bmatrix} A_{11} & A_{12} \cdots\cdots & A_{1n} \\ A_{12} & A_{22} \cdots\cdots & A_{2n} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ A_{n1} & A_{n2} \cdots\cdots & A_{nn} \end{bmatrix}$$

where the I-O model contains n processing sectors.

The I-O problem is that of determining the interindustry transactions or output required to sustain a given level of final demand. The solution of the input-output model can be obtained by rewriting equation (3.1) as

$$X_i = \sum_{j=1}^{n} a_{ij} X_j + Y_i \qquad (3.5)$$

If X represents a column sector of total output, A represents the direct coefficients matrix, and Y the column sector of final demand, then

$$X = AX + Y$$

$$X-AX = Y$$

$$(I-A)X = Y \qquad (3.6)$$

Employing the use of the identity matrix and matrix algebra, under the condition that (I-A) is non-singular, both sides of the equation can be multiplied by the inverse (I-A) yielding

$$(I-A)^{-1} (I-A)X = (I-A)^{-1}Y$$

then

$$X = (I-A)^{-1}Y \qquad (3.7)$$

where

X = total output sectors of the economy

Y = final demand sectors facing economy

Using the above formula, changes in output resulting from changes in final demand can be determined for each sector in the economy from the following equation:

$$X = (I-A)^{-1} \Delta Y \tag{3.8}$$

where

ΔY = column sector of changes in final demand

ΔX = column sector of changes in total output

$(I-A)^{-1}$ = matrix of direct and indirect coefficient

Application of Input-Output Model to Economic Impact Analysis

The flow table, direct coefficients table, and direct and indirect coefficients table are the basic analytical tools of the input-output model. They can be used in making impact analyses, predictions of economic activity, or in estimating productive requirements resulting from changes in final demand for an area's goods and services.

Economic impacts on the area resulting from changes in final demand are often measured through multipliers of the input-output model. Multipliers indicate the relationships between some observed change in the economy and the total change in economic activity created throughout the economy. The most common input-output multipliers are output, income, and employment.

Output Multiplier

The output multiplier measures the change in total output from all sectors resulting from a one dollar change in final demand for the product of that sector. Output multiplier Type I measures the sum of direct and indirect effects; on the other hand, output multiplier Type II measures direct, indirect, and induced effect of a one dollar change in final demand for the output of that sector. Output multiplier Type I is derived by summing the column entries of the direct and indirect matrix $(I-A)^{-1}$. The sum of each column is the output multiplier for the sector named at the head of the column. The Type II multiplier takes into account effects of consumer spending in addition to the direct and indirect interindustry effects. Output multiplier Type II is derived by summing the column entries of the direct, indirect, and induced matrix $(I-A_H)^{-1}$. The direct, indirect, and induced matrix $(I-A_H)^{-1}$ is derived by expanding the direct coefficient matrix (A) by inclusion of the household row and column thereby making the household sector endogenous. Since the additional induced impact resulting from the consumption expenditures on the economy is added to each Type I multiplier, each Type II multiplier is expected to be greater than its Type I counterpart.

The value of the total change in output of an economy resulting from a change in final demand for a given sector's output can be estimated by multiplying the sector's change in final demand by the output multiplier for that sector. However, this provides only an estimate of the total economic effect. To appraise the effect of the change on individual sectors of the economy, one must multiply the sector's column of direct and indirect coefficients by the change in final demand. Each product of the above multiplication will indicate the effect of the given final demand change on that particular sector in terms of output requirements. The sum of these individual sector output changes will equal the total change acquired originally by multiplying the sector output multiplier by the change in final demand. This is because the direct and indirect coefficients are merely the individual components of the output multiplier.

Income Multiplier

The income multiplier measures the total change in income throughout the economy resulting from a one dollar change in income in a given sector in response to a final demand change. The most common I-O income multipliers are the Type I and Type II. The basis of the income multipliers is that a certain amount of income is generated with each change in output of the economy. Type I and Type II income multipliers are computed from the direct, indirect and induced income effects estimated via an I-O model.

The Type I income multiplier is the ratio of direct and indirect income effects to direct income effects resulting from sectoral changes in final demand. The Type II income multiplier is the ratio of direct, indirect, and induced income effects per unit change in final demand of a given sector. It is computed for an I-O sector by dividing the household row entry in that sector's column of inverse coefficients by the direct income coefficient for that sector.

Direct income represents an estimate of the initial impact on household income per dollar change in output. It is the proportion of each dollar of output which goes to households in the form of wages and salaries, proprietor income, interest, rental income, or other forms of income. The direct income effect for each sector is found in the household row of the direct coefficient matrix, where households are endogenous, or in the household row of the payments sector where households are exogenous.

Indirect income is obtained by subtracting the direct income from the combined direct and indirect income of households. The direct and indirect income effects are the total changes in income resulting from a one dollar change in final demand in a particular sector. To compute the direct and indirect income effect of a sector, each column entry for that sector in the direct and indirect coefficients (inverse) matrix is multiplied by the corresponding household row entry of direct income coefficients sector. This multiplication is carried out for each sector in the inverse matrix. The sums of the products of this multiplication represent the direct and indirect income effects of changes in final demand for each column sector in the inverse matrix.

Induced income effects are computed by making households an endogenous sector and calculating direct and indirect coefficients for the new flow table (with households endogenous). The household row of the new matrix yields the direct, indirect, and induced income effects for each column sector.

Induced income is the direct, indirect, and induced income combined minus the direct and indirect income (computed with households exogenous). The induced income effect results from changes in household purchases of locally produced goods and services as household income changes. It takes into account consumer expenditures, and that a change in household receipts initiates a change in the level of local expenditures. These household expenditure changes cause output adjustments in the endogenous sectors and further changes in payments to local households in the economy. The assumption underlying this income multiplier is that changes in consumer spending are assumed proportional to changes in income, both in terms of quantity of income spent and expenditure patterns.

Employment Multiplier

The employment multiplier, as computed from an I-O model, is used to estimate changes in employment resulting from changes in final demand for the output of each endogenous sector. Employment multipliers define the change in total employment in the economy resulting from a one-unit change in the employment for a particular sector. The basic assumption underlying the employment multipliers is that, for each endogenous sector, a linear relationship exists between employment and output. There are Type I and Type II employment multipliers, which are similar to the Type I and Type II income multipliers.

The Type I employment multiplier for a sector is computed by dividing the direct and indirect employment effects resulting from a unit (one dollar, for example) change in final demand by the direct employment coefficient. The Type II employment multipliers are computed by dividing the direct, indirect, and induced employment effects resulting from a unit change in final demand by the direct employment coefficient.

The direct employment coefficient is obtained for each sector of the I-O model by dividing total sector employment by total sector output. The direct and indirect employment effects are estimated for each sector by multiplying the inverse matrix $(I-A)^{-1}$, with households exogenous, by a row vector of direct employment coefficients (which is merely a matrix of ratios of employment to output for each sector in the model) and summing the products for each sector (column) in the inverse matrix. Direct, indirect, and induced employment effects are estimated by multiplying the inverse matrix $(I-A_H)^{-1}$, with households endogenous, by a row vector of direct employment coefficients and summing the products of each column in the inverse matrix.

The direct employment coefficient of a sector multiplied by that sector's change in final demand provides an estimate of direct employment effects resulting from the final demand change. This estimate multiplied by that sector's employment multiplier equals total estimated employment changes in the economy due to the given change in final demand.

The total effect of a change in final demand on employment within the economy being modeled can be broken down into three components: direct employment changes which result from a specific sector's response to a change in its final demand; indirect employment changes which result from endogenous output adjustments required to directly and indirectly support a change in final demand of a given sector; and induced employment changes arising from a change in the level of local household consumption expenditures.

The Regional Input-Output Model

With increasing national concern for regional economic analysis the number of input-output models applied to regional economic studies has rapidly expanded. The input-output model applied to regional analysis has weaknesses in addition to those present in national application. Nevertheless, the input-output model is extensively applied in regional analysis. The predominant use of input-output in regional analysis has been a single region model which is the direct application of national input-output models to a single region. This type of model is called a regional input-output model.

Review of Methods of Construction of Regional Input-Output Tables

One of the major limitations in the use of the input-output model in regional economic analyses is the extensive data gathering process required in developing a flow table from primary data. For this reason, non-survey methods are frequently used to construct regional input-output tables. Non-survey methods generally start with either national coefficients or coefficients originally produced for other regions as a basis for technologies of the study region and then adjustments are made to take into account differences between the study region's economy and that of the nation or the surrogate region. According to the specificity of the data input needs, these techniques can be classified into four broad groups.

The first group of non-survey techniques estimates regional input-output coefficients, using detailed knowledge of local characteristics derived from data on industries or establishments whose technologies or trading patterns are suspected of differing from their national counterparts. This technique is called "the mixed approach", because the regional input-output coefficients are viewed as a mixture of purely national and purely regional interindustry relationships. Two examples of regional input-output models are used to illustrate this approach. As a first example, the Georgia Economic Model (94) was estimated by using the national I-O table as a first approximation to the State's table. This table was then adjusted with data on interindustry purchases and sales obtained by surveying a sample of firms. In addition, confidential industry-specific output, employment, and wage data were used to supplement the survey-based data and to serve as a further adjustment to the national table. These confidential data were gathered by various state government administrative agencies as part of their ongoing revenue and expenditure functions.

As a second example, the Multiregional Input-Output Model (MRIO) consists of linked I-O models for each state (85). MRIO is based on the following five data estimation techniques: (1) detailed, state-specific, interindustry relationships (obtained from various federal sources) for a number of industries, (2) state-specific output-weights of national coefficients for other industries, (3) various estimation techniques based on federal data sources for construction of the components of final demand, as well as industry-specific totals for output, employment, payrolls, and other measures related to value added, (4) special tabulations of the U.S. Census of Transportation for estimating interstate trade, and (5) reconciliation of the estimates obtained from the preceeding four procedures with values from national economic accounts and I-O tables. In several respects, the MRIO methodology for constructing each state I-O table is similar to that used in constructing the national I-O table, that is, while no surveys of establishments are used directly in estimating MRIO or national I-O coefficients, numerous federal data files are used. Because of the lack of actual data for some necessary components at the state level, when compared to national I-O tables, the MRIO methodology requires a more extensive use of estimation techniques to fill in the missing data.

The mixed approach of modifying a national table with limited survey or other region-specific data may require considerably less data gathering than a purely survey based table and, therefore, may entail lower associated cost. However, in terms of the need for experienced personnel, the costs of the two approaches are similar. In addition, the mixed approach frequently cannot be applied for small areas because of the unavailability of administrative data for these areas. In these respects, the mixed approach has the same drawbacks as a purely survey-based methodology.

The second broad group of national table adjustment procedures--the constraining of national technical coefficients, based on region-specific information--also requires a significant survey element. The RAS technique is an example of this type of adjustment procedure. The RAS technique was originally developed by Stone and Brown (99) for projecting national technical coefficients with limited survey data; it has also been used to estimate regional tables. In the regional applications of the RAS technique, national coefficients are constrained to regional industry, specific intermediate output and input control totals. As applied by Morrison and Smith (74), the control totals are obtained from survey data. While the RAS technique requires less primary data than the mixed approach, its data gathering costs often preclude its being applied in many small-area impact analyses, especially for a one-time set of changes in final demand.

A third group of techniques for adjusting the national tables to generate regional tables uses no survey data, but it makes use of economic data gathered by the Federal Government. For example, a methodology proposed by Stevens and Trainer (98) uses the Bureau of Labor Statistics Consumer Expenditure Survey and the Bureau of the Census regional economic data (especially, The Census of Transportation) for altering technical coefficients from the national table. This third group of non-survey techniques is similar to the first group; the major difference is that the adjustment data are not survey-based and often must be estimated for a particular area. This group of techniques avoids the large costs of gathering survey data and can be applied on a consistent basis to many small areas for interregional comparisons. However, there are two potential problems with this group of techniques. First, since Census data often are available only every five years, estimating current import levels in regional tables may be difficult. Second, much of the data actually used in adjusting national tables to small area tables are estimated by regression equations that are specified by the use of state or metropolitan area data for aggregated industry control totals. The estimated data, therefore, may not reflect actual relationships at the small-area level.

The fourth group of national table adjustment techniques makes use of generally available published data on industry specific employment or earnings to estimate the level of industry specific imports. The national table is then adjusted to the regional level by taking into account these imports. The major advantages of these techniques are their low application cost, and their ability to be applied even at the county level when making interarea multiplier comparisons.

The Location Quotient (LQ) and supply-demand pool techniques, as described by Schaffer and Chu (93), Schaffer (94) and Morrison and Smith (74), are examples of the fourth group of techniques. In comparing the LQ and the supply-demand pool techniques with survey-based tables, the studies indicate that the simple LQ technique is the most accurate of the non-survey techniques analyzed. However, the average multiplier generated by this LQ technique is considerably higher than the average multiplier estimated from the survey-based tables.

The Location Quotient Technique

The Oklahoma State Input-Output model is developed from the U.S. input-output coefficients based on the location quotient technique as described and developed by Schaffer and Chu (93). The location quotient (LQ) is a measure comparing the relative importance of an industry in a region and its relative importance in the nation. It is defined for industry i as:

$$LQ = \frac{X_i/X}{Z_i/Z} \tag{3.9}$$

where X_i represents the regional output of industry i, X the total regional output, Z_i the national output of industry i and Z the total output, all for the same base year.

The basic data required for the location quotient procedures are (1) national technical coefficient matrix, (2) state total output, and (3) state total final demand without trade for each sector. The state flow of goods and services to final demand sectors is computed separately. The basic function of the procedure is to compute the state interindustry transaction matrix, technical coefficient matrix, and interdependence matrix. The disposition of output in the transaction matrix can be defined as follows:

$$A^N X^A + Y^o = X^R$$

$$X^A - X^R = Y^T \tag{3.10}$$

where:

X^A = column vector of state total actual output

A^N = national direct coefficients matrix

Y^o = column vector of state total final demand without trade

X^R = column vector of state total required output

Y^T = column vector of state trade.

If the state's actual output for a particular sector is equal to the state's required output ($X^A = X^R$), the state sector is assumed to be just self-sufficient, that is, it has its "proper share". If the state's actual sector output is greater than the state's required output ($X^A > X^R$), the state sector, in this case, produces more than its proportionate share and exports its surplus production. In both situations, national technical coefficients ($A_{ij} = Z_{ij}/Z_j$) for that sector's row may be used directly to represent the state technical coefficients ($a_{ij} = X_{ij}/X_j$). In other words, if $LQ_i \geq 1$, then $a_{ij} = A_{ij}$. For the latter case, the surplus production by sector is put in the export column vector of final demand.

However, if the state's actual sector output is less than the state's required output ($X^A < X^R$), that is, if $LQ < 1$, the state produces less than its proportionate share and imports the deficit requirements. In this situation the state technical coefficients (a_{ij}) are not equal to the national technical coefficients (A_{ij}), but equal to $a_{ij} = LQ_i \cdot A_{ij}$. The national coefficients of the sector's row are reduced proportionally to account for the state's deficit production and the difference placed as an import row vector in the primary payments. The final state flow table is developed by including the interindustry flows, final demand and imports and exports derived in the manner explained above. Once the state flow table is developed, the state technical and interdependence coefficient matrices are obtained by mathematical manipulation of the derived state flow table by assuming a linear relationship between the purchases of a sector and the level of output of that sector.

Criticisms of Regional Input-Output Model

The single region input-output model has been criticized on several accounts. One criticism is that exports to and imports from other regions are lumped together without identifying their origin and destination. Generally, regional economies are far less self-sufficient. They are very dependent on other regions for supplies and markets. Regions are so closely interrelated that the impact of any proposed economic change on one region cannot be fully understood unless interregional relationships are studied. Another criticism is that the regional input-output model ignores feedback effects and the impact of economic changes in other regions on the study region. Although there is no general index, some empirical studies have shown that by ignoring the feedback effects, regional models have significantly underestimated the regional economic impacts (4). The input-output model which overcomes these defects is an interregional input-output model closed on the national boundary.

An Interregional Input-Output Model

Introduction

An interregional input-output model has been designed for multi-regional study. In an interregional input-output model, two sets of structural relationships, inter-industrial and interregional, are considered in combination. Industries are related by input-output activities and regions are related by trade. Economic activities are analyzed in terms of both input-output among industries and trade among regions. Structural coefficients of these relationships are, in Isard's notation, expressed as b_{ij}^{km}, where this is defined as the amount of commodity i from region k required to produce one dollar's worth of output by industry j in region m (52). Such two dimensional information, however, is generally not readily available.

The first fixed column coefficient interregional input-output model was developed by Chenery (14) and Moses (75). In this model, the interregional input-output coefficient (b_{ij}^{km}) is estimated by two separate coefficients, i.e. regional technical coefficient (a_{ij}^{m}) and trade coefficient (t^{km}). a_{ij}^{m} represents the i^{th} input required for producing one dollar's worth of j^{th} commodity in region m disregarding the region of its origin. t_{i}^{km} represents the fixed proportion of total receipts (consumption) of the i^{th} commodity by region m from region k. The trade coefficients are derived by ratios of a regions' purchase of a commodity from various regions including its own, and are derived from the base year trade flow estimates. Thus the sum of the coefficients equals one.

However, the above trade pattern does not specify the interindustry relationships between trading regions. It is assumed that each purchasing industry in region m purchases the same proportion of the i^{th} input from the region k. Thus, in the fixed column model:

$$b_{ij}^{km} = a_{ij}^{m} \cdot t_{i}^{km} \tag{3.11}$$

Having estimated the above two structural coefficients, a_{ij}^{m} and t_{ij}^{km}, the solution of the interregional input-output model is obtained by the following matrix equation:

$$X = (I-TA)^{-1}\ TY \qquad \text{or} \qquad X = (I-B)^{-1}\ TY. \qquad (3.12)$$

Structure and Theory of an Interregional Input-Output Model

This section will briefly illustrate the structure and theory of an interregional input-output model which was first introduced by Moses (12). Consider an economy in which there are only three industries: (1) agriculture, (2) manufacturing, and (3) services. The economy is divided into three regions: (1) East, (2) Middle West, and (3) West, which are open to one another for trade. Regions and regional flows will be described by superscripts; commodities and commodity flows by subscripts.

Input-output systems are usually presented in two sets of equations, one expressing certain balance relations and the other through both balance and structural relations. The balance equations of national input-output systems express the condition that the output of each industry is equal to its sales to all industries and final demand sectors. The balance equations of the interregional model simply add a regional dimension. They state that the output of each industry in each region is equal to its sales to all industries and final demand sectors in all regions. They are expressed as:

$$X_1^1-x_{11}^{11}-x_{12}^{11}-x_{13}^{11}-x_{11}^{12}-x_{12}^{12}-x_{13}^{12}-x_{11}^{13}-x_{12}^{13}-x_{13}^{13} = Y_1^{11}+Y_1^{12}+Y_1^{13}$$

$$X_2^1-x_{21}^{11}-x_{22}^{11}-x_{23}^{11}-x_{21}^{12}-x_{22}^{12}-x_{23}^{12}-x_{21}^{13}-x_{22}^{13}-x_{23}^{13} = Y_2^{11}+Y_2^{12}+Y_2^{13}$$

$$X_3^1-x_{31}^{11}-x_{32}^{11}-x_{33}^{11}-x_{31}^{12}-x_{32}^{12}-x_{33}^{12}-x_{31}^{13}-x_{32}^{13}-x_{33}^{13} = Y_3^{11}+Y_3^{12}+Y_3^{13}$$

$$X_1^2-x_{11}^{21}-x_{12}^{21}-x_{13}^{21}-x_{11}^{22}-x_{12}^{22}-x_{13}^{22}-x_{11}^{23}-x_{12}^{23}-x_{13}^{23} = Y_1^{21}+Y_2^{22}+Y_3^{23}$$

$$X_2^2-x_{21}^{21}-x_{22}^{21}-x_{23}^{21}-x_{21}^{22}-x_{22}^{22}-x_{23}^{22}-x_{21}^{23}-x_{22}^{23}-x_{23}^{23} = Y_1^{21}+Y_2^{22}+Y_3^{23}$$

$$X_3^2-x_{31}^{21}-x_{32}^{21}-x_{33}^{21}-x_{31}^{22}-x_{32}^{22}-x_{33}^{22}-x_{31}^{23}-x_{32}^{23}-x_{33}^{23} = Y_1^{21}+Y_2^{22}+Y_3^{23}$$

$$X_1^3-x_{11}^{31}-x_{12}^{31}-x_{13}^{31}-x_{11}^{32}-x_{12}^{32}-x_{13}^{32}-x_{11}^{33}-x_{12}^{33}-x_{13}^{33} = Y_1^{31}+Y_1^{32}+Y_1^{33}$$

$$X_2^3-x_{21}^{31}-x_{22}^{31}-x_{23}^{31}-x_{21}^{32}-x_{22}^{32}-x_{23}^{32}-x_{21}^{33}-x_{22}^{33}-x_{23}^{33} = Y_2^{31}+Y_2^{32}+Y_2^{33}$$

$$X_3^3-x_{31}^{31}-x_{32}^{31}-x_{33}^{31}-x_{31}^{32}-x_{32}^{32}-x_{33}^{32}-x_{31}^{33}-x_{32}^{33}-x_{33}^{33} = Y_3^{31}+Y_3^{32}+Y_3^{33}$$

In these equations, X, x, and Y represent respectively regional outputs, regional interindustry purchases, and regional final demand shipments. Thus X_1^3 is the output of agricultural goods in the West, x_{21}^{12} is the value of manufactured goods from the East consumed by the agricultural industry of the Middle West. The Y's require special interpretation.

The term final demand has two meanings in regional input-output systems. The first corresponds to that in national input-output models, i.e. the demands by the sectors in each region which must be given or known from outside the system since no functional relationships are postulated for them. The term final demand here refers to <u>receipts</u>. Each region may also contribute to satisfying final demand at home as well as in other regions. In this sense final demand signifies <u>shipments</u>. Thus Y is the demand for agricultural goods by the final demand sectors of the West. It is a datum. Y_1^{11}, Y_1^{12}, Y_1^{13} are the shipments of agricultural goods on final demand account by the East to itself, the Middle West and the West. These are unknown. The level of economic activity in a region is related more directly to its shipment on final demand account than to its receipts.

The balance equations of the interregional system are incapable of solution. For a three-region-three-industry case there are nine equations and 117 unknowns. However a solution can be obtained by introducing two sets of structural equations. The first set defines the structure of production in each region and the second defines the structure of trade among the regions.

Structure of Production

The structure of production in each region is manifest in the interindustry flow (or tranasactions) table. From the flow tables the direct production coefficients are derived as in a single region input-output model. The assumption is made that an industry's inputs are a constant proportion of its output. For example, in region one the technical coefficients can be shown as:

$$\begin{array}{cc} & \text{East} \\ \text{East} & \begin{bmatrix} a_{11}^{1} = \dfrac{x_{11}^{1}}{X_{1}^{1}} & a_{12}^{1} = \dfrac{x_{12}^{1}}{X_{2}^{1}} & a_{13}^{1} = \dfrac{x_{13}^{1}}{X_{3}^{1}} \\ a_{21}^{1} = \dfrac{x_{21}^{1}}{X_{1}^{1}} & a_{22}^{1} = \dfrac{x_{22}^{1}}{X_{2}^{1}} & a_{23}^{1} = \dfrac{x_{23}^{1}}{X_{3}^{1}} \\ a_{31}^{1} = \dfrac{x_{31}^{1}}{X_{1}^{1}} & a_{32}^{1} = \dfrac{x_{32}^{1}}{X_{2}^{1}} & a_{33}^{1} = \dfrac{x_{33}^{1}}{X_{3}^{1}} \end{bmatrix} \end{array}$$

The technical coefficient a_{12}^{1} is the amount of input purchased by industry two located in region one from industry one (located in any region) per unit of output in industry two. Technical coefficients are derived for each region in the same fashion. Technical coefficients of the three regions can be presented as a diagonal block matrix as in Table IV.

Structure of Trade

A second set of equations defines the per unit flow of commodities among and within regions. Again, fixed coefficients are assumed such that each region purchases its requirements of every good according to a fixed regional supply pattern. The structure of trade is identified by a set of trade coefficients for each good. The derivation of the trade coefficient is straight forward. Let r indicate the value of a region's purchases of a good from other regions and itself. Then r_{1}^{13} is the value of the agricultural goods (Sector 1) bought by region three from region one. The sum of purchases of agricultural goods from all regions by region three is indicated by R_{1}^{3}. The trade coefficient is obtained by division:

TABLE IV

BLOCK MATRIX OF REGIONAL TECHNICAL COEFFICIENTS

	I. East			II. Middle West			III. West		
	1. Agri- culture	2. Manu- facturing	3. Ser- vices	1. Agri- culture	2. Manu- facturing	3. Ser- vices	1. Agri- culture	2. Manu- facturing	3. Ser- vices
1. Agriculture	$a^1_{11} = \frac{x^1_{11}}{X^1_1}$	$a^1_{12} = \frac{x^1_{12}}{X^1_2}$	$a^1_{13} = \frac{x^1_{13}}{X^1_3}$						
2. Manufacturing	$a^1_{21} = \frac{x^1_{21}}{X^1_1}$	$a^1_{22} = \frac{x^1_{22}}{X^1_2}$	$a^1_{23} = \frac{x^1_{23}}{X^1_3}$						
3. Services	$a^1_{31} = \frac{x^1_{31}}{X^1_1}$	$a^1_{32} = \frac{x^1_{32}}{X^1_3}$	$a^1_{33} = \frac{x^1_{33}}{X^1_3}$						
1. Agriculture				$a^2_{11} = \frac{x^2_{11}}{X^2_1}$	$a^2_{12} = \frac{x^2_{12}}{X^2_2}$	$a^2_{13} = \frac{x^2_{13}}{X^2_3}$			
2. Manufacturing				$a^2_{21} = \frac{x^2_{21}}{X^2_1}$	$a^2_{22} = \frac{x^2_{22}}{X^2_2}$	$a^2_{23} = \frac{x^2_{23}}{X^2_3}$			
3. Services				$a^2_{31} = \frac{x^2_{31}}{X^2_1}$	$a^2_{32} = \frac{x^2_{32}}{X^2_2}$	$a^2_{33} = \frac{x^1_{33}}{X^2_3}$			

TABLE IV (Continued)

	I. East			II. Middle West			III. West		
	1. Agri-culture	2. Manu-facturing	3. Ser-vices	1. Agri-culture	2. Manu-facturing	3. Ser-vices	1. Agri-culture	2. Manu-facturing	3. Ser-vices
1. Agriculture							$a^3_{11} = \frac{x^3_{11}}{X^3_1}$	$a^3_{12} = \frac{x^3_{12}}{X^3_2}$	$a^3_{12} = \frac{x^3_{13}}{X^3_3}$
2. Manufacturing							$a^3_{21} = \frac{x^3_{21}}{X^3_1}$	$a^3_{22} = \frac{x^3_{22}}{X^3_2}$	$a^3_{23} = \frac{x^3_{23}}{X^3_3}$
3. Services							$a^3_{31} = \frac{x^3_{31}}{X^3_1}$	$a^3_{32} = \frac{x^3_{32}}{X^3_2}$	$a^3_{33} = \frac{x^3_{33}}{X^3_3}$

$$t_1^{13} = r_1^{13} \;/\; R_1^3 \tag{3.14}$$

The trade coefficients may also be presented as a block diagonal matrix as Table V. Here each block pertains to a good and describes the per unit trading patterns of all regions in this good. Since they are proportions, the trade coefficients in any column of a block add up to unity. Table V also presents symbolically the data from which trade coefficients are derived.

From the two sets of structural relations an interregional input-output coefficient matrix is derived which includes both trade and production coefficients. The interregional input-output coefficients (b_{ij}^{km})) indicate the proportion of sector i's output purchased by region m from region k to produce a unit of output in sector j. Thus, for example, $b_{12}^{32} = a_{12}^{2} \cdot t_1^{32}$. It is assumed that goods brought into the region are used in the same proportion by a region's industries as are inputs produced in the region.

Table VI presents an interregional coefficient matrix for a three region model. The fourth row block, total input (a_{ij}^{m}), gives the regional technical coefficients which show the inputs required by various producing industries from various supplying industries in order to produce one dollar's worth of output in region m without identifying the origin of inputs. a_{ij}^{1} represents the production function of region East and contain $3^2 = 9$ a_{ij}'s. In a three region model, there are $3^2 \times 3 = 27$ a_{ij}'s.

The sources of origin and amount of inputs required for the production in each region are shown in the first three row blocks.

TABLE V

BLOCK MATRIX OF TRADE COEFFICIENTS

		I. East	II. Middle West	III. West	I. East	II. Middle West	III. West	I. East	II. Middle West	III. West
1. Agriculture	I. East	$t_1^{11} = \frac{r_1^{11}}{R_1^1}$	$t_1^{12} = \frac{r_1^{12}}{R_1^2}$	$t_1^{13} = \frac{r_1^{13}}{R_1^3}$						
	II. Middle West	$t_1^{21} = \frac{r_1^{21}}{R_1^1}$	$t_1^{22} = \frac{r_1^{22}}{R_1^2}$	$t_1^{23} = \frac{r_1^{23}}{R_1^3}$						
	III. West	$t_1^{31} = \frac{r_1^{31}}{R_1^1}$	$t_1^{32} = \frac{r^{32}}{R_1^2}$	$t_1^{33} = \frac{r^{33}}{R_1^3}$						
2. Manufacturing	I. East				$t_2^{11} = \frac{r_2^{11}}{R_2^1}$	$t_2^{12} = \frac{r_2^{12}}{R_2^2}$	$t_2^{13} = \frac{r_2^{12}}{R_2^3}$			
	II. Middle West				$t_2^{21} = \frac{r_2^{21}}{R_2^1}$	$t_2^{22} = \frac{r_2^{22}}{R_2^2}$	$t_2^{23} = \frac{r_2^{23}}{R_2^3}$			
	III. West				$t_2^{31} = \frac{r_2^{31}}{R_2^1}$	$t_2^{32} = \frac{r_2^{32}}{R_2^2}$	$t_2^{33} = \frac{r_2^{33}}{R_2^3}$			

TABLE V (Continued)

		I. East	II. Middle West	III. West	I. East	II. Middle West	III. West	I. East	II. Middle West	III. West
3. Services	I. Fast							$t_3^{11} = \frac{r_3^{11}}{R_3^1}$	$t_3^{12} = \frac{r_3^{12}}{R_3^2}$	$t_3^{13} = \frac{r_3^{13}}{R_3^3}$
	II. Middle West							$t_3^{21} = \frac{r_3^{21}}{R_3^1}$	$t_3^{22} = \frac{r_3^{22}}{R_3^2}$	$t_3^{23} = \frac{r_3^{23}}{R_3^3}$
	III. West							$t_3^{31} = \frac{r_3^{31}}{R_3^1}$	$t_3^{32} = \frac{r_3^{32}}{R_3^2}$	$t_3^{33} = \frac{r_3^{33}}{R_3^3}$

TABLE VI

INTERREGIONAL INPUT-OUTPUT COEFFICIENT MATRIX

Consuming Region / Producing Region	I. East			II. Middle West			III. West		
	1. Agri-culture	2. Manu-facturing	3. Ser-vices	1. Agri-culture	2. Manu-facturing	3. Ser-vices	1. Agri-culture	2. Manu-facturing	3. Ser-vices
I. East									
1. Agriculture	$b^{11}_{11}=a^{1}_{11}(t^{11}_{1})$	$b^{11}_{13}=a^{1}_{12}(t^{11}_{1})$	$b^{11}_{13}=a^{1}_{13}(t^{11}_{1})$	$b^{12}_{11}=a^{2}_{11}(t^{12}_{1})$	$b^{12}_{12}=a^{2}_{12}(t^{12}_{1})$	$b^{12}_{13}=a^{2}_{13}(t^{12}_{1})$	$b^{13}_{11}=a^{3}_{11}(t^{13}_{1})$	$b^{13}_{12}=a^{3}_{12}(t^{13}_{1})$	$b^{13}_{13}=a^{3}_{13}(t^{13}_{1})$
2. Manufacturing	$b^{11}_{12}=a^{1}_{21}(t^{11}_{2})$	$b^{11}_{12}=a^{1}_{22}(t^{11}_{2})$	$b^{11}_{23}=a^{1}_{23}(t^{11}_{2})$	$b^{11}_{23}=a^{2}_{21}(t^{12}_{2})$	$b^{12}_{22}=a^{2}_{22}(t^{12}_{2})$	$b^{12}_{23}=a^{2}_{23}(t^{12}_{2})$	$b^{13}_{21}=a^{3}_{21}(t^{13}_{2})$	$b^{13}_{22}=a^{13}_{22}(t^{13}_{2})$	$b^{13}_{23}=a^{3}_{23}(t^{13}_{2})$
3. Services	$b^{11}_{31}=a^{1}_{31}(t^{11}_{3})$	$b^{11}_{32}=a^{1}_{32}(t^{11}_{3})$	$b^{11}_{33}=a^{1}_{33}(t^{11}_{3})$	$b^{21}_{31}=a^{2}_{31}(t^{12}_{3})$	$b^{12}_{32}=a^{2}_{32}(t^{13}_{3})$	$b^{12}_{33}=a^{12}_{33}(t^{13}_{3})$	$b^{13}_{31}=a^{3}_{31}(t^{13}_{3})$	$b^{13}_{32}=a^{3}_{32}(t^{13}_{3})$	$b^{13}_{33}=a^{3}_{33}(t^{13}_{3})$
II. Middle West									
1. Agriculture	$b^{21}_{11}=a^{1}_{11}(t^{21}_{1})$	$b^{21}_{12}=a^{1}_{12}(t^{21}_{1})$	$b^{31}_{13}=a^{31}_{13}(t^{21}_{1})$	$b^{22}_{11}=a^{2}_{11}(t^{22}_{1})$	$b^{22}_{12}=a^{2}_{12}(t^{22}_{1})$	$a^{22}_{13}=a^{2}_{13}(t^{22}_{1})$	$b^{23}_{11}=a^{3}_{11}(t^{23}_{1})$	$b^{23}_{12}=a^{3}_{12}(t^{23}_{1})$	$b^{23}_{13}=a^{3}_{13}(t^{23}_{1})$
2. Manufacturing	$b^{21}_{21}=a^{1}_{21}(t^{21}_{2})$	$b^{21}_{22}=a^{1}_{22}(t^{21}_{2})$	$b^{21}_{23}=a^{1}_{23}(t^{21}_{2})$	$b^{22}_{21}=a^{2}_{21}(t^{22}_{2})$	$b^{22}_{22}=a^{2}_{22}(t^{22}_{2})$	$a^{22}_{23}=a^{2}_{23}(t^{22}_{1})$	$b^{23}_{21}=a^{23}_{21}(t^{23}_{1})$	$b^{23}_{22}=a^{3}_{22}(t^{23}_{2})$	$b^{23}_{23}=a^{3}_{23}(t^{23}_{2})$
3. Services	$b^{21}_{31}=a^{1}_{31}(t^{21}_{3})$	$b^{21}_{32}=a^{1}_{32}(t^{21}_{3})$	$b^{21}_{33}=a^{1}_{33}(t^{22}_{3})$	$b^{22}_{31}=a^{22}_{32}(t^{22}_{3})$	$b^{22}_{32}=a^{2}_{32}(t^{22}_{3})$	$a^{22}_{33}=a^{2}_{33}(t^{22}_{3})$	$b^{23}_{31}=a^{3}_{31}(t^{23}_{3})$	$b^{23}_{32}=a^{3}_{32}(t^{23}_{3})$	$b^{23}_{33}=a^{3}_{33}(t^{23}_{3})$
III. West									
1. Agriculture	$b^{31}_{11}=a^{1}_{11}(t^{31}_{1})$	$b^{31}_{12}=a^{1}_{12}(t^{31}_{1})$	$b^{31}_{13}=a^{1}_{13}(t^{31}_{1})$	$b^{32}_{11}=a^{2}_{11}(t^{32}_{1})$	$b^{32}_{12}=a^{2}_{12}(t^{32}_{1})$	$b^{32}_{11}=a^{3}_{11}(t^{33}_{1})$	$b^{33}_{11}=a^{3}_{11}(t^{33}_{1})$	$b^{33}_{12}=a^{3}_{12}(t^{33}_{1})$	$b^{33}_{13}=a^{3}_{13}(t^{33}_{1})$
2. Manufacturing	$b^{31}_{21}=a^{1}_{21}(t^{31}_{2})$	$b^{31}_{22}=a^{1}_{22}(t^{31}_{2})$	$b^{31}_{23}=a^{1}_{23}(t^{31}_{2})$	$b^{32}_{21}=a^{2}_{21}(t^{32}_{2})$	$b^{32}_{22}=a^{2}_{22}(t^{32}_{2})$	$b^{32}_{23}=a^{2}_{23}(t^{32}_{2})$	$b^{33}_{21}=a^{3}_{21}(t^{33}_{2})$	$b^{33}_{22}=a^{3}_{22}(t^{33}_{2})$	$b^{33}_{23}=a^{3}_{23}(t^{33}_{2})$
3. Services	$b^{21}_{31}=a^{1}_{31}(t^{31}_{2})$	$b^{31}_{32}=a^{1}_{32}(t^{31}_{3})$	$b^{31}_{33}=a^{1}_{33}(t^{31}_{2})$	$b^{32}_{31}=a^{2}_{31}(t^{32}_{3})$	$b^{22}_{32}=a^{2}_{32}(t^{32}_{3})$	$b^{32}_{33}=a^{2}_{33}(t^{33}_{3})$	$b^{33}_{31}=a^{3}_{31}(t^{33}_{3})$	$b^{33}_{32}=a^{3}_{32}(t^{33}_{3})$	$b^{33}_{33}=a^{3}_{33}(t^{33}_{3})$
Total Inputs									
1. Agriculture	a^{1}_{11}	a^{1}_{12}	a^{1}_{13}	a^{2}_{11}	a^{2}_{12}	a^{2}_{13}	a^{3}_{11}	a^{3}_{12}	a^{3}_{13}
2. Manufacturing	a^{1}_{21}	a^{1}_{22}	a^{1}_{23}	a^{2}_{21}	a^{2}_{22}	a^{2}_{23}	a^{3}_{21}	a^{3}_{22}	a^{3}_{23}
3. Services	a^{1}_{31}	a^{1}_{32}	a^{1}_{33}	a^{2}_{31}	a^{2}_{32}	a^{2}_{33}	a^{3}_{31}	a^{3}_{32}	a^{3}_{33}
		a^{1}_{ij}			a^{2}_{ij}			a^{3}_{ij}	

The $b_{ij}^{11} = a_{ij}^{1} \cdot t_{ij}^{11}$ in the first row block in the East region represents intraregional input shipments which are the conventional input-output tables in a single region input-output model. The second and third row blocks in the same region $b_{ij}^{11} = a_{ij}^{1} \cdot t_{ij}^{21}$ and $b_{ij}^{31} = a_{ij}^{1} \cdot t_{ij}^{31}$ represent inputs which are imported from each industry in the Middle West and Western regions, respectively.

With the information of technical coefficients and trade coefficients, the set of nine balance equations, now solvable, can be rewritten as:

$$X_1^1-b_{11}^{11}X_1^1-b_{12}^{11}X_2^1-b_{13}^{11}X_3^1-\cdots\cdots-b_{11}^{13}X_1^3-b_{12}^{13}X_2^3-b_{13}^{13}X_3^3 = t_1^{11}Y_1^1+t_1^{12}Y_1^2+t_1^{13}Y_1^3$$

$$X_2^1-b_{21}^{11}X_1^1-b_{22}^{11}X_2^1-b_{33}^{11}X_3^1-\cdots\cdots-b_{21}^{13}X_1^3-b_{22}^{13}X_2^3-b_{23}^{13}X_3^3 = t_2^{11}Y_2^1+t_2^{12}Y_2^2+t_2^{13}Y_2^3$$

$$X_3^1-b_{31}^{11}X_1^1-b_{32}^{11}X_2^1-b_{33}^{11}X_3^1-\cdots\cdots-b_{31}^{13}X_1^3-b_{32}^{13}X_2^3-b_{33}^{13}X_3^3 = t_3^{11}Y_3^1+t_3^{12}Y_3^2+t_3^{13}Y_3^3$$

$$X_1^2-b_{11}^{21}X_1^1-b_{12}^{21}X_2^1-b_{13}^{21}X_3^1-\cdots\cdots-b_{11}^{23}X_1^3-b_{12}^{23}X_2^3-b_{12}^{23}X_3^3 = t_1^{21}Y_1^1+t_1^{22}Y_1^2+t_1^{23}Y_1^3$$

$$X_2^2-b_{21}^{21}X_1^1-b_{22}^{21}X_2^1-b_{23}^{21}X_3^1-\cdots\cdots-b_{21}^{23}X_1^3-b_{22}^{23}X_2^3-b_{23}^{23}X_3^3 = t_2^{21}Y_2^1+t_2^{22}Y_2^2+t_2^{23}Y_2^3$$

$$X_3^2-b_{31}^{21}X_1^1-b_{32}^{21}X_2^1-b_{33}^{21}X_3^1-\cdots\cdots-b_{31}^{23}X_1^2-b_{32}^{23}X_2^3-b_{32}^{23}X_3^3 = t_3^{21}Y_3^1+t_3^{22}Y_3^2+t_3^{23}Y_3^3$$

$$X_3^2-b_{31}^{21}X_1^1-b_{32}^{11}X_2^1-b_{33}^{21}X_3^1-\cdots\cdots-b_{31}^{23}X_1^3-b_{32}^{23}X_2^3-b_{32}^{23}X_3^3 = t_3^{21}Y_3^1+t_3^{22}Y_3^2+t_3^{23}Y_3^3$$

$$X_3^2-b_{31}^{21}X_1^1-b_{32}^{11}X_2^1-b_{33}^{21}X_3^1-\cdots\cdots-b_{31}^{23}X_1^3-b_{32}^{23}X_2^3-b_{32}^{23}X_3^3 = t_3^{21}Y_3^1+t_3^{22}Y_3^2+t_3^{23}Y_3^3$$

$$X_1^3-b_{11}^{31}X_1^1-b_{12}^{31}X_2^1-b_{13}^{31}X_3^1-\cdots\cdots-b_{11}^{33}X_1^3-b_{12}^{33}X_2^3-b_{13}^{33}X_3^3 = t_1^{31}Y_1^1+t_1^{32}Y_1^2+t_1^{33}Y_1^3$$

In the above system, bX's are substituted for interindustry purchases of the original balance equations, and tY's are substituted for the unknown final demand shipments. For instance, X is substituted by $b_{13}^{22}X_3^2$, and Y_1^{23} is substituted by $t_1^{23}Y_1^3$. Since there are nine equations, the nine unknown regional outputs can be determined. Balances of trade for pairs of regions or for a single region with respect to all others can be obtained from the trade coefficients and total demands for each commodity in each region.

The balance equation system may also be presented in the matrix form as follows:

$$[I-B]X = TY \tag{3.16}$$

Then, the output solutions are obtained from the following equation:

$$X = [I-B]^{-1}\ TY \tag{3.17}$$

where:

$$X = \begin{bmatrix} X_1^1 \\ X_2^1 \\ X_3^1 \\ X_1^2 \\ X_2^2 \\ X_3^2 \\ X_1^3 \\ X_2^3 \\ X_3^3 \end{bmatrix}, \qquad B = \begin{bmatrix} b_{11}^{11} & b_{12}^{11} & b_{13}^{11} & \cdots & b_{11}^{13} & b_{12}^{13} & b_{13}^{13} \\ b_{21}^{11} & b_{22}^{11} & b_{23}^{11} & \cdots & b_{21}^{13} & b_{22}^{13} & b_{23}^{13} \\ \vdots & \vdots & \vdots & & \vdots & \vdots & \vdots \\ b_{31}^{31} & b_{32}^{31} & b_{33}^{31} & \cdots & b_{31}^{33} & b_{32}^{33} & b_{33}^{33} \end{bmatrix}$$

9 X 1   9 X 9

$$
T = \begin{bmatrix}
\xi_1^{11} & \xi_1^{12} & \xi_1^{13} & & & & & & \\
\xi_2^{11} & \xi_2^{12} & \xi_2^{13} & & & & & & \\
\xi_3^{11} & \xi_3^{12} & \xi_3^{13} & & & & & & \\
 & & & \xi_1^{21} & \xi_1^{22} & \xi_1^{23} & & & \\
 & & & \xi_2^{21} & \xi_2^{22} & \xi_2^{23} & & & \\
 & & & \xi_3^{21} & \xi_3^{22} & \xi_3^{23} & & & \\
 & & & & & & \xi_1^{31} & \xi_1^{32} & \xi_1^{33} \\
 & & & & & & \xi_2^{31} & \xi_2^{32} & \xi_2^{33} \\
 & & & & & & \xi_3^{31} & \xi_3^{32} & \xi_3^{33}
\end{bmatrix}
$$

9 X 9

$$
Y = \begin{bmatrix}
Y_1^1 \\
Y_1^2 \\
Y_1^3 \\
Y_2^1 \\
Y_2^2 \\
Y_3^2 \\
Y_3^1 \\
Y_3^2 \\
Y_3^3
\end{bmatrix}
$$

9 X 1

Application of An Interregional Input-Output Model to Economic Impact Analysis

The Basic Data

Interregional input-output enables the study of interindustry and interegional dependencies and derivation of sector multipliers for output, income and employment at desired disaggregated industrial levels. Economic impact multipliers of an interregional input-output model are derived in a similar manner as those of a regional input-output model. The multipliers of an interregional model are greater than their regional multiplier counterparts since the interregional trade effects are included in the model.

The basic data sources for various multipliers are (1) regional technical coefficients (A), (2) interregional trade coefficients (T), (3) interregional input-output coefficients (B), (4) interregional direct and indirect coefficients $(I-B)^{-1}$, and (5) interregional direct, indirect and induced coefficients $(I-B_H)^{-1}$.

While technical coefficients provide the information of direct input requirements from various supplying industries in order to produce one dollar's worth of output by a purchasing industry disregarding their regional origin, interregional direct requirements provide the regional origin of these inputs. One can find direct and indirect requirements from the various supplying industries in the various regions to yield a dollar's worth of output to final users by a purchasing industry in a particular region. This information is obtained by inverting the matrix (I-TA) or (I-B). The direct, indirect and induced requirements are obtained by inverting the matrix $(I-T_H A_H)$ or $(I-B_H)$, where $T_H A_H$ includes the household sector in the TA matrix.

Output Multipliers

The output multiplier for the i^{th} industry measures the total requirements from all sectors needed to deliver one additional dollar of output to the final users. The Type I multiplier measures direct and indirect requirements; on the other hand, the Type II multiplier measures direct, indirect, and induced requirements. The Type I multiplier is derived by summing the column entries of the $(I-TA)^{-1}$ or $(I-B)^{-1}$ matrix under the i^{th} industry and the Type II multiplier is derived by summing the same column entries of the $(I-T_H A_H)^{-1}$ or $(I-B_H)^{-1}$ matrix. Since output includes both industrial and final demand, the output multiplier indicates linkage effects of each industry. The higher the multiplier, the higher the industry's linkage with other industries.

Income Multipliers

The output multiplier is convenient in measuring total shipment and linkage effects, but it does not measure the impact in terms of income which is a more convenient form of the economic growth index. Income multipliers are also derived from the basic tables discussed in the earlier sections. As in the output multipliers, income multipliers are classified into Type I and Type II multipliers and the meanings of these multipliers are analogous to those of the output multipliers.

Type I Income Multiplier. The Type I income multiplier is expressed as the ratio of the direct plus the indirect income changes to the direct income change resulting from a dollar increase in final demand for any given sector. The direct income change for each industrial sector is given by household row entry of the interregional I-O table and direct coefficient table in terms of household coefficients.

The direct and indirect income change is derived by multiplying each column entry of an industrial sector in a region in the $(I-B)^{-1}$ matrix by the supplying industry's corresponding household row coefficient from the direct coefficient table and summing the multiplied results along the column. Type I income multiplier represents the direct and indirect change in income resulting from a dollar increase in direct income. It is worth noting that this income results from a dollar change in direct income but not a dollar increase in final demand. To increase direct income by a dollar, the final demand must increase more than a dollar.

Type II Income Multipliers. Type II income multipliers are derived by dividing the direct, indirect, and induced income changes by the direct income change resulting from the increase of a dollar's worth of delivery by an industry to the final users in a region. The direct, indirect, and induced income changes to yield a dollar's worth of i^{th} output in j^{th} region of final users is shown in the household row entries in the $(I-B_H)^{-1}$ matrix. In the case of the three region model, income changes due to the delivery of one dollar's output by the first industrial sector in Region I is the sum of the three household rows under the first industry of $(I-B_H)^{-1}$ matrix. The direct income change is shown in the direct coefficient table. As in the case of output multipliers, the Type II multipliers are greater than their Type I counterpart due to the induced impacts.

Employment Multipliers

The employment multiplier is used to estimate changes in employment resulting from changes in final demand for the output of each endogenous sector in a particular region. Employment multipliers define the change in total employment in the regional economy resulting from a one-unit change in the employment for a particular sector. There are Type I and Type II employment multipliers, which are similar to Type I and Type II income multipliers.

The Type I employment multiplier for a sector is computed by dividing the direct and indirect employment effects resulting from a unit change in final demand by the direct employment coefficients. The direct and indirect effects are derived by multiplying the $[I-B]^{-1}$ matrix by a row vector of direct employment coefficients, and summing the products of each sector along the column of the inverse matrix. The direct employment coefficients are obtained by dividing total sector employment by total sector output.

The Type II employment multiplier is computed by dividing the direct, indirect, and induced employment effects resulting from a unit change in final demand by the direct employment coefficients. The direct, indirect, and induced employment effects are estimated by multiplying the $(I-B_H)^{-1}$ matrix by a row vector of direct employment coefficients and summing the products for each column in the inverse matrix.

Input-Output Price Model

Introduction

The purpose of this section is to describe the theoretical framework of an input-output model that can be used to study the regional impact caused by energy price changes. First, the national input-output price model which is a dual version of the national input -output model, will be discussed as described by Leontief (61). Then a dual version of the interregional input-output model will be described. An interregional input-output price model is an extension of the national price model and has been described by Polenske (85) and Young (136).

National Price Model

Prices are determined in an input-output model from a set of equations which state that the price which each productive sector of the economy receives per unit of its output must equal the total outlays incurred in the course of its production. These outlays comprise not only payments for inputs purchased from the same and from the other industries, but also the "value added", which essentially represents payments made to the exogenous sectors.

The above relationship can be described by the set of balance equations of the dual of the national input-output model. Each equation shows the balance between total outlays and the component purchases.

Consider again an input-output model with three industries. Then the three dual balance equations are presented as:

$$p_1X_1 = p_1X_{11}+p_2X_{21}+p_3X_{31}+U_1$$

$$p_2X_2 = p_1X_{12}+p_2X_{22}+p_3X_{32}+U_2 \tag{3.18}$$

$$p_3X_3 = p_1X_{13}+p_2X_{23}+p_3X_{33}+U_3$$

where

p_j = price of the output produced by industry j,

P_jX_{ij} = the dollar value of output of industry i bought by industry j,

P_jX_j = the total output, in dollars, of industry j,

U_j = the dollar value of value added in industry j.

As in the case with the primal input-output model, equation system (3.18) can be rewritten by replacing each p_jX_{ij} on the right hand side with the corresponding $p_ja_{ij}X_j$ terms. Equation system (3.19) results:

$$p_1X_1 = p_1a_{11}X_1+p_2a_{21}X_1+p_3a_{31}X_1+U_1$$

$$p_2X_2 = p_1a_{12}X_2+p_2a_{22}X_2+p_3a_{32}X_2+U_2 \tag{3.19}$$

$$p_3X_3 = p_1a_{13}X_3+p_2a_{23}X_3+p_3a_{33}X_3+U_3$$

The prices of the output produced by the three industries can be obtained by dividing all the terms in each of the three equations in system (3.19) by the appropriate output, X_j:

$$p_1 = p_1a_{11}+p_2a_{21}+p_3a_{31}+v_1$$

$$p_2 = p_1a_{12}+p_2a_{22}+p_3a_{32}+v_2 \qquad (3.20)$$

$$p_3 = p_1a_{13}+p_2a_{23}+p_3a_{33}+v_3$$

Thus, the price of each output equals the unit cost of production, which includes the costs of the inputs of intermediate goods and services $[p_ja_{ij}]$ as well as the value added costs per unit of output $[v_j=U_j/X_j]$.

To solve the dual input-output model for the prices, P, in any given year, an analyst requires a set of technical coefficients, A, for a base year and a set of value-added-per-unit-of-output coefficients, V, for the given year. The method of implementing the model is analogous to that used for the primal model. The solution is easiest to follow using matrix notation:

$$P = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \end{bmatrix} \qquad A = \begin{bmatrix} a_{11} & a_{21} & a_{31} \\ a_{12} & a_{22} & a_{32} \\ a_{13} & a_{23} & a_{33} \end{bmatrix}$$

$$V = \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$$

Equation system (3.20) can now be rewritten as:

$$P = \hat{A}P + V \qquad (3.21)$$

The solution for the m prices is obtained as follows:

$$P - \hat{A}P = V \tag{3.22}$$

$$(I-\hat{A})P = V \tag{3.23}$$

$$P = [I-\hat{A}]^{-1}V \tag{3.24}$$

where

$\hat{A}$ = transpose of the matrix of technical coefficients

P = vector of normalized industrial prices

V = vector of value-added-per-unit of output

Using equation (3.24), the commodity prices are determined as a function of the $(I-\hat{A})^{-1}$ matrix and the value-added-per-unit of output vector V. The $(I-\hat{A})^{-1}$ matrix is the exact transpose of the $(I-A)^{-1}$ matrix in the primal input-output model.

Given the particular set of information used, a solution for the value system of equations is directly obtainable through the fact that the entire system in dollars is normalized to 1.0. Each coefficient, a_{ij}, in the technical coefficient matrix represents the dollar value of good i purchased by industry j to produce one dollar of good j. In the input-output accounting framework, the sum of the costs of all intermediate and primary factor inputs used to produce a unit of good j must be equal to the total value of output of one unit of good j. The technical coefficient matrix normalizes these costs in relation to one dollar of the commodity produced. In other words, the total cost of production for one unit of output for each industry is equal to one dollar and that is also the price of the unit of output produced by the industry, because in a competitive system cost equals price.

The normalization of output prices to 1.0 allows the technical coefficient matrix, measured in value terms, to be used in the price model. By the use of the truncated price model developed later in this chapter, output price changes can be computed as deviations from 1.0. A computed price of $1.25, for example, is interpreted as a 25 percent increase from the base price.

Interregional Input-Output Price Model

The interregional input-output price model is an expansion of the national price model by incorporating a set of structural interregional trade coefficients. Whereas in the national price model the intersectoral linkages in a national economy can be shown, in the interregional input-output price model, the interregional as well as the interindustrial linkages in a regional economy can be shown.

The fixed supply form of the static interregional input-output price model is formulated using the following three assumptions:

1. Constant technology coefficients. No substitution among inputs is allowed to occur in response to relative changes in input prices. This is a severe limitation when the price model is used for long-range forecasts, because factor substitution will occur in the long run, resulting in inaccuracies in the technical coefficients. However, in the short run, this assumption is less important. Carter (11) has verified through empirical tests using U.S. data that the national technical coefficients are relatively stable in the short run.

2. Constant trade coefficients. No substitution among supplying regions is allowed to occur. This assumption implies that the trade relationships between regions will not change as input prices change. Thus, a region is assumed to continue supplying a given proportion of the consumption of another region.

3. Constant industrial shares. Each industry in a given region is assumed to continue purchasing a fixed share of the total amount of a given good supplied to the region. This assumption is made in order to reduce the amount of data required to implement the model.

To implement the interregional input-output price model, three basic sets of interregional data are required: (1) trade coefficients, (2) technical coefficients, and (3) value added-per-unit-of-output coefficients.

The interregional trade coefficient matrix [T] and the interregional technical coefficient matrix [A] are required for the construction of the interregional input-output coefficient matrix [TA or B] as described earlier in the interregional input-output model. The third basic set of data is the value-added-per-unit-of- output vector [V]. Each element in this vector denotes the value added required for producing one unit of output of a particular commodity in a region.

With these three basic sets of data, the interregional input-output price model can be implemented. To form the interregional input-output price model, the national price model is modified by replacing the matrix of technical coefficients (A) by the interregional input-output coefficient matrix [B], i.e. to incorporate the trade between regions into the system.

For example, an interregional input-output price model with three regions and three industries. Using the following matrix notations:

$$P = \begin{bmatrix} p^1_1 \\ p^1_2 \\ p^1_3 \\ p^2_1 \\ p^2_2 \\ p^2_3 \\ p^3_1 \\ p^3_2 \\ p^3_3 \end{bmatrix} \qquad V = \begin{bmatrix} v^1_1 \\ v^1_2 \\ v^1_3 \\ v^2_1 \\ v^2_2 \\ v^2_3 \\ v^3_1 \\ v^3_2 \\ v^3_3 \end{bmatrix}$$

$$\hat{B} = \begin{bmatrix} b^{11}_{11} & b^{11}_{21} & b^{11}_{31} & b^{21}_{11} & b^{21}_{21} & b^{21}_{31} & b^{31}_{11} & b^{31}_{21} & b^{31}_{31} \\ b^{11}_{13} & b^{11}_{23} & b^{11}_{33} & b^{21}_{12} & b^{21}_{22} & b^{21}_{32} & b^{31}_{12} & b^{31}_{22} & b^{31}_{32} \\ b^{11}_{13} & b^{11}_{23} & b^{11}_{33} & b^{21}_{13} & b^{21}_{23} & b^{21}_{33} & b^{31}_{13} & b^{31}_{23} & b^{31}_{33} \\ b^{12}_{11} & b^{12}_{21} & b^{12}_{31} & b^{22}_{11} & b^{22}_{21} & b^{22}_{31} & b^{32}_{11} & b^{32}_{21} & b^{32}_{31} \\ b^{12}_{12} & b^{12}_{22} & b^{12}_{32} & b^{22}_{12} & b^{22}_{22} & b^{22}_{32} & b^{32}_{12} & b^{32}_{22} & b^{32}_{32} \\ b^{12}_{12} & b^{12}_{23} & b^{12}_{33} & b^{22}_{13} & b^{22}_{23} & b^{22}_{33} & b^{32}_{12} & b^{32}_{23} & b^{32}_{33} \\ b^{13}_{11} & b^{13}_{21} & b^{13}_{31} & b^{23}_{11} & b^{23}_{21} & b^{23}_{31} & b^{33}_{11} & b^{33}_{21} & b^{33}_{31} \\ b^{13}_{12} & b^{13}_{22} & b^{13}_{32} & b^{23}_{12} & b^{23}_{22} & b^{23}_{32} & b^{33}_{12} & b^{33}_{22} & b^{33}_{32} \\ b^{13}_{12} & b^{13}_{23} & b^{13}_{33} & b^{23}_{13} & b^{23}_{23} & b^{23}_{33} & b^{33}_{13} & b^{33}_{23} & b^{33}_{33} \end{bmatrix}$$

where

P = vector of output prices for three regions and three industries

V = vector of value-added-per-unit-of-output coefficients for three regions and three industries

$\hat{B}$ = transpose of the matrix of interregional input-output coefficients [B]

The matrix of interregional input-output coefficients, B, has been obtained by the same procedure as described in the section of an interregional input-output model.

The prices of commodities in the base interregional input-output model are the sum of the value of intermediate inputs imported from all industries and regions required for the production of one unit of output of a particular commodity plus the value added per unit of output required for that commodity. Expressed in matrix notation, the system of nine structural balance equations for an interregional price model for three regions and three industries can be presented as:

$$P = \hat{B}P + V \tag{3.25}$$

$$P - \hat{B}P = V \tag{3.26}$$

$$[I - \hat{B}]P = V \tag{3.27}$$

$$P = [I - \hat{B}]^{-1}V \tag{3.28}$$

Using equation (3.28), the commodity prices are determined as a function of the $[I-\hat{B}]^{-1}$ matrix and the value-added-per-unit-of output coefficients vector. The base interregional price model can be used to estimate commodity price changes due to increases or decreases in the value added component needed in the production of certain commodities. An increase in the value-added-per-unit-of-output for a particular industry in a region can be substituted in the appropriate term in the V vector. Using equation (3.28), the commodity price vector [P] can be calculated by matrix-multiplying the $[I-\hat{B}]^{-1}$ matrix by the revised V vector.

Truncated Interregional Input-Output Price Model

The commodity price changes resulting from changes in the value added per unit of output for a particular commodity in a region can be estimated using the base interregional input-output price model. This model can be extended to trace the price repercussions in a multiregional economy resulting from regional commodity price changes.

The base interregional input-output price model serves as the foundation for the development of the truncated model to estimate commodity prices resulting from commodity price changes. To implement the truneated model certain commodity prices are exogenously determined. For example, if the price of petroleum products in a particular region has increased by 20 percent over the base price, the petroleum products price is exogenously set to 1.20. The price increase in that region will affect the commodity prices in other industries and regions through the use of the higher-priced petroleum products as intermediate inputs in their production. The column that corresponds to the use of this higher-priced petroleum products is truncated from the $\hat{B}$ matrix. The row in the $\hat{B}$ matrix that corresponds to the use of the other commodities as intermediate inputs in the production of the higher-priced petroleum products is also truncated, as the exogenously determined price is assumed not to be affected by other commodity prices. If the base model consists of n equations and an m x n $\hat{B}$ matrix, the truncated model will consist of n x $(n-\alpha)$ equations and an $(n-\alpha) \times (n-\alpha)$ $\hat{B}'$ matrix, where is the number of commodity prices determined exogenously.

One final step is required. Each element in the column of the $\hat{B}$ matrix that denotes the use of the higher-priced petroleum products as intermediate inputs in the production of other commodities is multiplied by the exogenously determined price and added into the model. The linkage between the exogenously determined petroleum products industry and other industries in the same region and in other regions are included in the model.

To illustrate the development of the truncated model in detail, the three-region, three-industry, case will be used to estimate the effect of a 20 percent increase in the price of the commodity produced by the first industry in the first region. The price is exogenously determined such that $p_1^1=1.20$. The commodity prices for the other industries in Region I and for all industries in Region 2 and 3 are now affected by the price increase. These eight commodity prices can be written in an 8 x 1 P* sector where the p_1^1 term is now eliminated (the * will indicate a truncated matrix).

The price increase of industry one in Region 1 affects the other industry prices through the trade of its commodities and their use as intermediate inputs in the production of other commodities. The elements in the first column of the $\hat{B}$ matrix represent the trade and use of commodity one from Region 1 as intermediate inputs. Then each element of this vector is multiplied by the exogenously set price of commodity one in Region 1, each term is the value of the intermediate input of commodity one from Region 1 needed to produce one unit of the commodity manufactured by the particular industry. This vector is the intermediate production cost effect and is denoted as the C vector in the matrix notation.

The first term in the C vector is truncated, as this is the input of commodity one for the production of commodity one within the first region. The truncated C* vector is now obtained and expressed as:

$$C^* = \begin{bmatrix} b^{11}_{12}p^{1}_{1} \\ b^{11}_{13}p^{1}_{1} \\ b^{11}_{11}p^{1}_{1} \\ b^{12}_{12}p^{1}_{1} \\ b^{12}_{13}p^{1}_{1} \\ b^{13}_{12}p^{1}_{1} \\ b^{13}_{12}p^{1}_{1} \\ b^{13}_{13}p^{1}_{1} \end{bmatrix} \qquad (3.29)$$

where $p^{1}_{1} = 1.20$

The $\hat{B}$ matrix is truncated to an 8 x 8 $\hat{B}^*$ matrix, where the column corresponding to the outflow of industry one from Region one to other industries and regions and the row corresponding to the inflow of commodities as intermediate inputs for the production of commodity one in Region one are excluded. The truncated $\hat{B}^*$ is matrix-multiplied by the P* vector to obtain the value of intermediate-inputs-per-unit-of output vector.

Finally, the value-added-per-unit-of-output coefficient vector (V) must be truncated to an 8 x 1 vector, V*, where the term corresponding to the value added per unit of output for commodity one in Region one is excluded.

The prices of commodities are equal to the sum of the value of intermediate inputs (other than those of commodity one from Region one) required for the production of one unit of output in the particular industry, the immediate production cost effect of the use of the higher-priced commodity one from Region one, and the value added required per unit of output. Therefore, the price of a commodity is equal to the total production costs per unit of output.

The eight-equation system can be rewritten in matrix notation as:

$$P^* = \hat{B}^* P^* + C^* + V^* \tag{3.30}$$

where

P^* = the truncated commodity price vector

$\hat{B}^*P^*$ = the truncated value of intermediate input-per-unit-of-output-vector, excluding the commodities where prices are determined exogenously

C^* = the truncated immediate production cost effect vector for those commodities whose price is determined exogenously, and

V^* = the truncated value-added-per-unit-of-output coefficient vector.

By writing out equation (3.30) in full, an eight-equation system in eight unknowns is obtained. This eight-equation system differs from the nine-equation system obtained from the base price model by the exclusion of the price equation for commodity one in Region one. The C^* vector is the first column of terms in the nine-equation system that corresponds to the cost of using commodity one from Region one as an intermediate input.

The commodity prices can be obtained by isolating the P* vector in equation (3.30) and solving:

$$P^* - \hat{B}^* P^* = C^* + V^* \tag{3.31}$$

$$[I - \hat{B}^*] P^* = C^* + V^* \tag{3.32}$$

$$P^* = [I - \hat{B}^*]^{-1} [C^* + V^*] \tag{3.33}$$

Using equation (3.33), the commodity prices are a function of the $[I-\hat{B}^*]^{-1}$ matrix, the truncated value-added-per-unit-of-output coefficient vector, V*, and the immediate production cost effect vector, C*. The truncated model can be extended to estimate commodity price changes resulting from a number of exogenously determined prices. If α prices were exogenously set, the $\hat{B}$ matrix would be truncated to an $(n-\alpha) \times (n-\alpha)$ $\hat{B}^*$ matrix, where columns and rows correspond to the inflows and outflows of those commodities. The V vector would also be truncated to an $(n-\alpha) \times 1$ vector. Those terms corresponding to the V vector for these industries whose prices have been exogenously set will be excluded in the truncated V* vector. There will be $(n-\alpha) \times 1$ immediate production cost effect vectors, C*, corresponding to those industries whose prices have been set.

Equation (3.33) can be used to estimate commodity price changes for a variety of combinations of initial regional and commodity price increases and decreases. The truncated model can be used to conduct policy analyses for a wide range of pricing alternatives. These policy alternatives can be analyzed by the appropriate truncation of the $\hat{B}$ matrix and V vector and the creation of a C* vector reflecting the regional and industrial commodity price changes.

Modification of an Interregional Input-Output Price Model for Economic Impact Analysis

The truncated interregional input-output price model forecasts the impacts of exogenous changes in output prices of one or more industries on the output of the remaining industries. This model alone is not sufficient to trace the final impacts of output price changes on output, income, and employment of the region. However, with some modifications to the structure of the interregional input-output model, these impacts can be measured.

Taylor (100) develops a methodology for updating the input-output technical coefficient matrix when commodity prices are changing. His model can be borrowed for adjusting the interregional input-output coefficients to cope with changes in commodity prices resulting from an exogenous change of output prices of one or more industries. Hence, the final impacts of commodity price changes on output, income, and employment can be easily traced through the multiplier analysis of an interregional input-output model.

The model can be restated as follows:

The demand-supply balance equation of an input-output model is rewritten by inclusion of commodity prices as:

$$P_i X_i = \sum_{j=1}^{n} P_i X_{ij} + P_i Y_i \qquad (3.34)$$

where X_i is an index of total output in industry i in the price of some base year, P_i is a price index for the sector, X_{ij} are its sales to sector j for intermediate users, and Y_i is the sum of sector i final demands less competitive imports.

In most applications of input-output analysis, it is assumed that intermediate purchases X_{ij} of commodity i by sector j are related to its output level X_j by a fixed coefficient a_{ij}. That is:

$$X_{ij} = a_{ij}X_j \tag{3.35}$$

where a_{ij} is assumed not to vary in response to price changes.

If the input-output coefficients are fixed but prices vary across sectors, it is convenient to rewrite Equations (3.34) and (3.35) as:

$$P_iX_i = \sum_{j=1}^{n} (P_ia_{ij}/P_j)P_jX_j + P_iY_i \tag{3.36}$$

In Equation (3.36) sector output and final demand levels are expressed in current price terms and the input-output coefficients are revalued as P_ia_{ij}/P_j to keep the accounting consistent. In a base year, all prices are set to unity, so they cancel out in Equation (3.36). However, if prices shift over time relative to each other, they do not cancel, and the more complicated expression for input-output coefficients has to be used.

The next step is to express input-output in matrix terms. In base year when all prices are one and cancel out, we have the familiar balance equations.

$$\begin{bmatrix} X_1 \\ \vdots \\ X_n \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{13} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ \vdots \\ X_n \end{bmatrix} + \begin{bmatrix} Y_1 \\ \vdots \\ Y_n \end{bmatrix}$$

This expression can be restated in matrix notation as:

$$X = AX + Y \qquad (3.37)$$

where X is a column vector of output levels, A is an nxn matrix of input-output coefficients, and Y is a column vector of final demand. Then the standard solution of the input-output model is obtained by:

$$X = (I-A)^{-1}Y \qquad (3.38)$$

This standard formula permits the computation of gross output levels required to satisfy a vector of final demands Y after intermediate input requirements are taken into account.

To generalize these equations for varying prices, the simplest procedure is to introduce the diagonal price matrices.

$$\hat{P} = \begin{bmatrix} P_1 & 0 \cdots\cdots & 0 \\ 0 & P_2 \cdots\cdots & 0 \\ \vdots & \vdots & \vdots \\ 0 & 0 \cdots\cdots & P_n \end{bmatrix} \qquad (3.39)$$

and

$$\hat{P}^{-1} = \begin{bmatrix} 1/P_1 & 0 \cdots\cdots & 0 \\ 0 & 1/P_2 \cdots\cdots & 0 \\ \vdots & \vdots & \vdots \\ 0 & 0 \cdots\cdots & 1/P_n \end{bmatrix} \qquad (3.40)$$

Using these 'hat' matrices, Equation (3.36) can be rewritten as:

$$\hat{P}X = (\hat{P}A\hat{P}^{-1})\,\hat{P}X + \hat{P}Y \qquad (3.41)$$

and the flexible price analog to (3.38) becomes:

$$\hat{P}X = [I-\hat{P}A\hat{P}^{-1}]^{-1}\,\hat{P}Y \tag{3.42}$$

Equation (3.41) and (3.42) show how to make current price estimates of output levels required to support a vector of final demand PY when both prices and quantities demanded are changing.

The above model can easily be applied to the interregional input-output model when regional commodity prices are changing.

The diagonal price matrices are now representing interregional price matrices:

$$P^* = \begin{bmatrix} P^1_1 & 0 & \cdots & 0 & \cdots & 0 & 0 & \cdots & 0 \\ 0 & P^1_2 & \cdots & 0 & \cdots & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots & & \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & P^1_n & \cdots & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & \ddots & \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & P^n_1 & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 & \cdots & 0 & P^n_2 & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & 0 & 0 & \cdots & P^n_n \end{bmatrix}$$

and

$$P^{*-1} = \begin{bmatrix} 1/P^1_1 & 0 & \cdots & 0 & \cdots & 0 & 0 & \cdots & 0 \\ 0 & 1/P^1_2 & \cdots & 0 & \cdots & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots & & \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & 1/P^1_n & \cdots & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & \ddots & \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & 1/P^n_1 & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 & \cdots & 0 & 1/P^n_2 & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & 0 & 0 & \cdots & 1/P^n_n \end{bmatrix}$$

Then the structure balance equation of an interregional input-output model can be rewritten as:

$$P^*X = (P^*BP^{*-1})\ P^*X + P^*TY \tag{3.45}$$

and

$$P^*X = [I-P^*BP^{*-1}]^{-1}\ P^*TY \tag{3.46}$$

where B is an interregional input-output coefficient matrix, T is an interregional trade coefficient matrix, and Y is a vector of interregional final demand levels.

Equations (3.45) and (3.46) show how to incorporate changes in commodity prices into an interregional input-output model. If P* represents a diagonal matrix of output price changes resulting from an exogenous change in one or more commodity prices as determined in the truncated interregional input-output price model, then Equation (3.46) can be used to determine the final impacts of exogenous changes of output prices on the sector output levels once the final demand levels are given.

The inverse matrix, $[I-P^*BP^{*-1}]^{-1}$, represents the new structural component of an interregional input-output model. It can be used to forecast the final impacts of commodity price changes on the output, income and employment of the region through the process of the conventional interregional multiplier analysis.

CHAPTER IV

OKLAHOMA REGIONAL AND INTERREGIONAL INPUT-OUTPUT MODELS

Empirical regional and interregional input-output models with 81 processing sectors for the state of Oklahoma and the Rest of U.S. for the base year 1977 are presented in this chapter. The chapter is presented in two parts: (1) Oklahoma regional input-output model and (2) Oklahoma and Rest of U.S. (RUS) interregional input-output model.

Oklahoma Regional Input-Output Model

Sector Specification

The Oklahoma regional input-output structure is basically derived from the input-output structure of the United States for 1977. The base year 1977 is chosen since it is the most recent year for which comprehensive statistics exist. In 1977, the U.S. Department of Commerce conducted four major censuses that are most relevant to the regional input-output data. They are the Censuses of Manufacturers, Mineral Industries, Construction Industries and Government. The Census of Agriculture was conducted in 1978. In October, 1981, the Bureau of Economic Analysis (BEA) completed updating Input-Output tables of the

U.S. economy for 1973, 1974 and 1975 from the benchmark national input-output table for 1972 (110). These four benchmark national input-output tables were used as the basis for extrapolating the 1977 U.S. input-output technical coefficients. The Oklahoma input-output table for 1977 was derived from these updated national input-output technical coefficients based on the location quotient technique as described in Chapter III. The Rest of U.S. input-output table was derived directly from the U.S. technical coefficients.

The Oklahoma regional input-output table consists of 81 processing (or purchasing) sectors, six dummy and special industries, and nine final demand sectors. Industry aggregation and classification by Standard Industrial Classification (SIC) codes are illustrated in detail in Appendix A.

According to the developed input-output structure for the state of Oklahoma and the Rest of U.S., there are four sectors of agricultural activities, four sectors of mining except fuels, two sectors of construction, 52 sectors of manufacturing, 13 sectors of service-type activities, two government sectors, and four energy producing sectors. All these make up the 81 processing sectors of the study. A complete listing of the sectors, which are referred to throughout this study, is presented in Table VII along with the associated SIC codes.

Characteristics of Regional Input-Output Tables

The regional input-output tables have the same characteristics as the national input-output tables. The row entries of the regional

TABLE VII

INDUSTRY CLASSIFICATION OF THE 1977 OKLAHOMA INPUT-OUTPUT TABLE

Industry Number and Title	Related Census-SIC Codes (1972 Edition)
Agriculture, Forestry and Fisheries	
1. Livestock and livestock products	pt. 01, pt. 02
2. Crops and other agricultural products	pt. 01, pt. 02
3. Forestry and fishery products	081-4, 091, 097
4. Agricultural, forestry and fishery services	0254, 07 (excl, 074), 085, 092
Mining Except Fuels	
5. Iron and ferroalloy ores mining	101, 106
6. Nonferrous metal ores mining	102-5, pt. 108, 109
7. Stone and clay mining and quarrying	141-5, pt. 148, 149
8. Chemical and fertilizer mineral mining	147
Construction	
9. New construction	pt. 15-17, pt. 108, pt. 1112, pt. 1212, pt. 148
10. Maintenance and repair construction	pt. 15-17, pt. 138
Manufacturing	
11. Ordnance and accessories	3482-4, 3489, 3761, 3795
12. Food and kindred products	20
13. Tobacco manufacturers	21
14. Broad and narrow fabrics, yarn and thread mills	221-4, 226, 228
15. Miscellaneous textile goods and floor coverings	227, 229
16. Apparel	225, 23 (excl. 239)
17. Miscellaneous fabricated textile products	239
18. Lumber and wood products, except containers	241-3, 2448, 249
19. Wood containers	2441, 2449
20. Household furniture	251
21. Other furniture and fixtures	252-4, 259
22. Paper and allied products, except containers and boxes	261-4, 266
23. Paperboard containers and boxes	265
24. Printing and publishing	27

TABLE VII (Continued)

Industry Number and Title	Related Census-SIC Codes (1972 Edition)
Manufacturing (Continued)	
25. Chemicals and selected chemical products	281, 286-7, 289
26. Plastics and synthetic materials	282
27. Drugs, cleaning and toilet preparations	283-4
28. Paints and allied products	285
29. Paving and roofing materials	295
30. Rubber and miscellaneous plastic products	30
31. Leather tanning and finishing	311
32. Footwear and other leather products	313,7, 319
33. Glass and glass products	321-2
34. Stone and clay products	324-9
35. Primary iron and steel manufacturing	331-2, 339, 3462
36. Primary nonferrous metals manufacturing	333-6, 3463
37. Metal containers	341
38. Heating, plumbing, and fabricated structural metal products	343-4
39. Screw machine products and stampings	345, 3465-6, 3469
40. Other fabricated metal products	342, 347, 349
41. Engines and turbines	351
42. Farm and garden machinery	352
43. Construction and mining machinery	3531-3
44. Materials handling machinery and equipment	3534-7
45. Metalworking machinery and equipment	354
46. Special industry machinery and equipment	355
47. General industrial machinery and equipment	356
48. Miscellaneous machinery, except electrical	359
49. Office, computing, and accounting machines	357
50. Service industry machines	358
51. Electrical transmission and distribution equipment and industrial apparatus	361-2, 3825
52. Household appliances	363
53. Electric lighting and wiring equipment	364
54. Radio, TV and communication equipment	365-6
55. Electronic components and accessories	367
56. Miscellaneous electrical machinery, equipment and supplies	369
57. Motor vehicles and equipment	371
58. Aircraft and parts	372
59. Other transportation equipment	373-5, 3792, 3799, 2451
60. Professional, scientific, and controlling instruments and supplies	381, 3822-4, 3829, 384 387
61. Optical, ophthalmic, and photographic equipment and supplies	383, 385-6
62. Miscellaneous manufacturing	39

TABLE VII (Continued)

Industry Number and Title	Related Census-SIC Codes (1972 Edition)
Transportation, Communication, and Utilities	
63. Transportation and warehousing	40-2, 44-7
64. Communications, except radio and TV	481-2, 489
65. Radio and TV broadcasting	483
66. Water supply and sanitary services	494, 495, 496
Wholesale and Retail Trade	
67. Wholesale and retail trade	50-57, 59, 7396, 8042
Finance, Insurance and Real Estate	
68. Finance and insurance	60-74, 67
69. Real estate and rental	65-6, pt. 1531
Services	
70. Hotels and lodging, personal and repair services (except auto)	70-72, 762-4, pt. 7699
71. Business services	73 (excl. 7396), 7692, 7694, pt. 7699
72. Eating and drinking places	58
73. Automobile repair and services	75
74. Amusements	78-9
75. Health, educational and social services and nonprofit organizations	074, 80 (excl. 8042), 32-84, 86, 8992
Government Enterprises	
76. Federal government enterprises	not applicable
77. State and local government enterprises	not applicable
Energy Producing	
78. Petroleum production	291, 299, 131 pt., 132 pt.
79. Natural gas production	492, 131 pt., 132, 138 pt.
80. Coal mining	111, pt. 1112, 1211, pt. 1211
81. Electricity and hydropower	491

TABLE VII (Continued)

Industry Number and Title	Related Census-SIC Codes (1972 Edition)
Dummy and Special Industries	
82. Noncomparable imports	
83. Scrap, used and second-hand goods	
84. Government industry	
85. Rest of the world industry	
86. Household industry	
87. Inventory valuation adjustment	
TI Total input	
VA Value added	
Final Demand (FD)	
91. Personal consumption expenditures	
92. Gross private domestic fixed investment	
93. Change in business inventories	
94. Exports	
95. Imports	
96. Federal government purchases, national defense	
97. Federal government purchases, non-defense	
98. State and local government purchases, education	
99. State and local government purchases, other	

input-output table represent the dollar value of use by each industry and sales to final demand of the output of the commodity named at the beginning of the row. The column entries are the dollar value of inputs of commodities and value added generated in production in the industry named at the column head.

Total regional consumption for each sector is the sum of interindustry inputs (TI) and final demand (FD). Final demand is the sum of nine components: (1) personal consumption expenditure; (2) gross private domestic fixed investment; (3) change in business inventories; (4) exports; (5) imports; (6) federal government purchases; (7) national defense; (8) state and local government purchases, education; and (9) state and local government purchases, other.

In both national and regional input-output tables, imports are treated in a special way. Imported commodities that are comparable to domestically produced commodities are included with the distribution of the output of the comparable domestically produced commodity. Their domestic port value is shown as a negative entry in the import column of final demand. In this way, the row total for each commodity equals the domestic production of that commodity. Imports that are not comparable to domestically produced commodities are shown in the row for non-comparable imports at foreign port value. The total of this row is shown where the row for imports intersects the column for imports.

Total Sector Output

Total regional output for each sector is equal to regional production plus non-comparable imports and other dummy and special industries. These dummy industries are scrap, used and second-hand goods (sector 83); government industry (sector 84); rest of the world industry (sector 85); household industry (sector 86); and inventory valuation adjustment (sector 87). They are used only to keep industry output totals consistent. These entries are related to the accounting procedures used to construct the table. After applying the location quotient technique these dummy industries can be eliminated.

The location quotient technique was used to estimate the Oklahoma input-output table. Data needed for the location quotient technique are entries in the national flow table and total output for each regional sector. The location quotient procedure compares the percentage share of individual sector output of a region to the percentage share of that sector output in the nation.

Data and methods in obtaining the sector total output for Oklahoma and the Rest of U.S. for the base year 1977 are explained in Appendix A. Data on total sector output for U.S., Oklahoma and the Rest of U.S. in 1977 are presented in Table VIII.

In 1977, all processing sectors of the U.S. produced \$3,058,856 million of output, while all processing sectors in Oklahoma produced \$34,131 million or 1.12 percent of national output and the Rest of U.S. produced \$3,024,725 million or 98.88 percent. Values of total output for the aggregated procesing sectors of Oklahoma are: \$2,420 million for agriculture, forestry, and fisheries; \$163 million for mining except fuels; \$2,367 million for construction; \$9,286 million for manufacturing; \$14,032 million for transportation, communication, trade and services; and \$5,413 million for energy processing industries.

TABLE VIII

TOTAL SECTOR OUTPUT, 1977
(THOUSAND DOLLARS)

Input-Output Sector	U.S.	Oklahoma	Rest of U.S.
1. Livestock and livestock products	63,831,000	1,205,114	62,625,886
2. Crops and other agricultural products	85,892,000	1,067,433	84,824,567
3. Forestry and fishing products	3,478,600	25,404	3,453,196
4. Agricultural, forestry and fishing services	13,107,100	121,783	12,985,317
Agricultural, Forestry and Fisheries	166,308,700	2,419,734	163,888,966
5. Iron and ferralloy ores mining	1,986,000	0	1,986,100
6. Nonferrous metal ores mining	3,541,600	6,959	3,534,641
7. Stone and clay mining and quarrying	4,564,700	144,174	4,420,526
8. Chemical and fertilizer	2,167,200	11,507	2,155,693
Mining Except Fuels	12,259,600	163,640	12,096,960
9. New construction	180,678,163	1,944,003	178,734,160
10. Maintenance and repair construction	34,166,156	422,951	33,743,205
Construction	214,844,320	2,366,954	212,477,370
11. Ordnance and accessories	10,346,392	14,963	10,331,429
12. Food and kindred products	199,093,015	1,650,120	197,442,895
13. Tobacco industries	11,545,801	0	11,545,801
14. Broad and narrow fabrics, yarn and thread mills	31,918,400	38,533	31,879,867
15. Miscellaneous textile goods and floor coverings	9,038,500	79,297	8,959,203
16. Apparel	32,375,000	274,283	32,100,177
17. Miscellaneous fabricated textile products	8,280,600	57,394	8,223,206
18. Lumber and wood products, except containers	39,102,500	256,852	38,845,648
19. Wood containers	1,222,600	6,895	1,215,705
20. Household furniture	10,514,000	47,659	10,466,341
21. Other furniture and fixtures	6,709,600	23,018	6,686,582
22. Paper and allied products except containers and boxes	39,096,100	202,298	38,893,802
23. Paperboard containers and boxes	13,400,500	46,544	13,353,956
24. Printing and publishing	49,973,800	344,768	49,629,032
25. Chemicals and selected chemical products	61,675,300	354,503	61,320,797

TABLE VIII (Continued)

Input-Output Sector	U.S.	Oklahoma	Rest of U.S.
26. Plastics and synthetic materials	20,230,500	3,214	20,227,286
27. Drugs, cleaning and toilet preparations	30,888,500	13,204	30,875,296
28. Paints and allied products	6,703,100	25,249	6,677,851
29. Paving and roofing materials	3,679,800	61,247	3,618,553
30. Rubber and miscellaneous plastic products	40,064,100	742,975	39,321,125
31. Leather tanning and finishing	1,467,600	7,200	1,460,400
32. Footwear and other leather products	6,205,700	12,472	6,193,228
33. Glass and glass products	9,245,300	181,510	9,063,790
34. Stone and clay products	26,031,500	286,462	25,745,038
35. Primary iron and steel manufacturing	62,998,000	164,475	62,833,525
36. Primary nonferrous metal manufacturing	40,271,600	134,967	40,136,633
37. Metal containers	9,327,100	13,490	9,313,610
38. Heating, plumbing and fabricated structural metal products	30,264,400	717,219	29,547,181
39. Screw machiner products and stampings	20,281,400	34,578	20,246,822
40. Other fabricated metal products	30,592,800	257,308	30,335,492
41. Engine and turbine	10,686,800	32,956	10,653,844
42. Farm and garden machinery	11,879,200	54,250	11,825,150
43. Construction and mining machinery	18,547,200	726,142	17,821,058
44. Materials handling machinery and equipment	5,195,200	32,246	5,162,954
45. Metal working machinery and equipment	13,621,000	15,757	13,605,243
46. Special industry machinery and equipment	9,265,000	111,847	9,153,153
47. General industrial machinery and equipment	16,857,900	256,548	16,601,352
48. Miscellaneous machinery, except electrical	8,255,000	112,622	8,142,378
49. Office, computing and accounting machines	17,396,300	216,733	17,179,567
50. Service industry machines	12,621,500	94,913	12,526,587
51. Electrical transmission and distribution equipment and industrial apparatus	15,669,200	60,233	15,608,967
52. Household appliances	10,886,900	5,676	10,881,224
53. Electric lighting and wiring equipment	8,504,600	16,731	8,487,869
54. Radio, TV and communication equipment	30,261,500	656,073	29,605,427

TABLE VIII (Continued)

Input-Output Sector	U.S.	Oklahoma	Rest of U.S.
55. Electronic components and accessories	15,717,300	48,876	15,668,424
56. Miscellaneous electrical machinery, equipment and supplies	9,179,300	17,849	9,161,451
57. Motor vehicles and equipment	119,981,080	267,499	119,713,581
58. Aircrafts and parts	26,002,900	251,680	25,751,220
59. Other transportation equipment	15,884,100	62,464	15,821,636
60. Professional, scientific, and controlling instruments and supplies	17,022,000	46,848	16,975,152
61. Optical, ophthalmic, and photographic equipment and supplies	12,375,300	68,142	12,307,158
62. Miscellaneous manufacturing	19,524,092	77,674	79,446,418
Manufacturing	1,287,877,080	9,286,456	1,278,590,624
63. Transportation and warehousing	111,385,000	1,672,775	109,712,225
64. Communications, except radio and TV	44,145,900	437,883	43,708,017
65. Radio and TV broadcasting	6,335,000	75,317	6,259,683
66. Water supply and sanitary services	4,825,600	72,826	4,752,774
Transportation, communication and utilities	166,691,500	2,258,801	164,432,699
67. Wholesale and retail trade	301,116,400	3,573,348	297,543,052
68. Finance and insurance	112,423,500	1,164,370	111,259,130
69. Real estate and rental	244,905,200	2,888,657	242,016,543
Finance, insurance and real estate	357,328,700	4,053,027	353,275,673
70. Hotels and lodging, personal and repair services (except auto)	44,218,102	529,759	43,688,343
71. Business services	54,500,405	571,254	53,929,151
72. Eating and drinking places	61,307,142	687,210	60,619,932
73. Automobile repair and services	21,575,500	245,887	21,329,613
74. Amusements	21,143,209	117,356	21,025,853
75. Health, educational and social services and non-profit organization	211,596,117	1,995,097	209,601,020
Services	414,340,475	4,146,563	410,193,912

TABLE VIII (Continued)

Input-Output Sector	U.S.	Oklahoma	Rest of U.S.
76. Federal government enterprises	15,500,094	257,913	15,242,181
77. State and local government enterprises	20,963,500	191,494	20,772,006
Government enterprises	36,463,594	449,407	36,014,187
78. Petroleum product production	48,371,806	2,902,346	45,469,460
79. Natural gas production	15,139,397	1,398,008	13,741,389
80. Coal mining	14,970,779	106,054	14,864,725
81. Electricity and hydropower	23,143,804	1,006,955	22,136,849
Energy processing	101,625,786	5,413,363	96,212,423
Total Processing Sectors	3,058,856,155	34,131,293	3,024,724,862

Regional shares of national output in 1977 are presented in Table IX. Oklahoma, in general, represents only small shares of national output. Few processing sectors in Oklahoma account for more than two percent of national output. Among the highest regional shares for Oklahoma are natural gas production (9.23 percent); petroleum products production (6.00 percent); stone and clay mining and quarrying (3.16 percent); radio, TV, communication equipment (2.17 percent); livestock and livestock products (1.89 percent); and crop and other agricultural products (1.87 percent).

The 1977 regional interindustry flows for Oklahoma are not presented in this study. The 1977 Oklahoma and Rest of U.S. direct coefficient matrices are presented in Appendix Tables. In these tables, the dummy and special industries were eliminated and the non-comparable import row was included in the value added row (VA).

Oklahoma and Rest of U.S. Interregional Input-Output Model

The previous section presented the input-output model and provided data and data sources. This section presents the empirical results of the interregional model. It consists of three components: (1) technology matrix; (2) trade matrix, and (3) interregional input-output matrix.

Technology Matrix

The technology matrix of the interregional input-output model is a block diagonal matrix showing the regional technical coefficient

TABLE IX

REGIONAL SHARE OF NATIONAL OUTPUT

Input-Output Sector	Oklahoma (percent)	Rest of U.S.
1. Livestock and livestock products	1.89	98.11
2. Crops and other agricultural products	1.87	98.13
3. Forestry and fishery product	0.73	99.27
4. Agricultural, forestry and fishery services	0.93	99.07
5. Iron and ferroalloy ores mining	0.00	100.00
6. Nonferrous metal ores mining	0.20	99.80
7. Stone and clay mining and quarrying	3.16	96.84
8. Chemical and fertilizer mineral mining	0.53	99.47
9. New construction	1.07	98.93
10. Maintenance and repair construction	1.24	98.76
11. Ordnance and accessories	0.14	99.86
12. Food and kindred products	0.83	99.17
13. Tobacco manufactures	0.00	100.00
14. Broad and narrow fabrics, yarn and thread mills	0.12	99.88
15. Miscellaneous textile goods and floor coverings	0.88	99.12
16. Apparel	0.88	99.12
17. Miscellaneous fabricated textile products	0.69	99.31
18. Lumber and wood products, except containers	0.66	99.34
19. Wood containers	0.56	99.44
20. Household furniture	0.45	99.55
21. Other furniture and fixtures	0.34	99.66
22. Paper and allied products, except containers	0.52	99.48
23. Paperboard containers and boxes	0.35	99.65
24. Printing and publishing	0.69	99.31
25. Chemicals and selected chemical products	0.57	99.43
26. Plastics and synthetic materials	0.16	99.84
27. Drugs, cleaning and toilet preparations	0.43	99.57
28. Paints and allied products	0.38	99.62
29. Paving and roofing material	1.66	98.34
30. Rubber and miscellaneous plastic products	1.85	98.15
31. Leather tanning and finishing	0.49	99.51
32. Footwear and other leather products	0.20	99.80
33. Glass and glass products	1.96	98.04
34. Stone and clay products	1.10	98.90
35. Primary iron and steel manufacturing	0.26	99.74
36. Primary nonferrous metal manufacturing	0.34	99.66
37. Metal containers	0.14	99.86
38. Heating, plumbing and structural metal products	2.37	97.63

TABLE IX (Continued)

Input-Output Sector	Oklahoma (percent)	Rest of U.S.
39. Screw machine products and stamping	0.17	99.83
40. Other fabricated metal products	0.84	99.16
41. Engines and turbines	0.31	99.69
42. Farm and garden machinery	0.46	99.54
43. Construction and mining machinery	3.92	96.08
44. Materials handling, machinery and equipment	0.62	99.38
45. Metal working machinery and equipment	0.12	99.88
46. Special industry machinery and equipment	1.21	98.79
47. General industrial machinery and equipment	1.52	98.48
48. Miscellaneous machinery, except electrical	1.36	98.64
49. Office, computing and accounting machines	1.25	98.75
50. Service industry machines	0.75	99.25
51. Electric industrial equipment and apparatus	0.38	99.62
52. Household appliances	0.05	99.95
53. Electric lighting and wiring equipment	0.20	99.80
54. Radio, TV and communication equipment	2.17	97.83
55. Electronic components and accessories	0.31	99.69
56. Miscellaneous electrical machinery and supplies	0.19	99.81
57. Motor vehicles and equipment	0.22	99.78
58. Aircraft and parts	0.97	99.03
59. Other transportation equipment	0.39	99.61
60. Scientific and controlling instruments	0.28	99.72
61. Optical, ophthalmic and photo equipment	0.55	99.45
62. Miscellaneous manufacturing	0.40	99.60
63. Transportation and warehousing	1.50	98.50
64. Communications, except radio and TV	0.99	99.01
65. Radio and TV broadcasting	1.19	98.81
66. Water supply and sanitary services	0.15	99.85
67. Wholesale and retail trade	1.19	98.81
68. Finance and insurance	1.04	98.96
69. Real estate and rental	1.18	98.82
70. Hotels; personal and repair services except auto	1.20	98.80
71. Business services	1.05	98.95
72. Eating and drinking places	1.12	98.88
73. Automobile repair and services	1.14	98.86
74. Amusements	0.55	99.45
75. Health educational and special services and nonprofit organizations	0.94	99.06

TABLE IX (Continued)

Input-Output Sector	Oklahoma (percent)	Rest of U.S. (percent)
76. Federal government enterprises	1.66	98.34
77. State and local government enterprises	0.91	99.09
78. Petroleum products production	6.00	94.00
79. Natural gas production	9.23	90.77
80. Coal mining	0.71	99.29
81. Electricity and hydropower	4.33	98.00

matrices. Thus for the two regions of Oklahoma and Rest of U.S., the technology matrix is:

$$A = \left[\begin{array}{c|c} A^{OK} & 0 \\ \hline 0 & A^{RUS} \end{array}\right] \quad (4.1)$$

Technical coefficients for Oklahoma for the non-energy processing sectors for the base year 1977 were derived from the national input-output table. Technical coefficients for the energy processing sectors of Oklahoma were estimated separately and are presented in Chapter VI.

The technical coefficient matrix for the Rest of U.S. was derived directly from the national input-output coefficients. Since Oklahoma output accounts for only small shares of U.S. output, while the Rest of U.S. accounts for nearly 99 percent of national output the U.S. national technology coefficients are substituted for A^{RUS}.

The petroleum products production (sector 78) of the energy processing sector needs special attention. The petroleum products production sector of this study is a combination between crude petroleum and petroleum refining industries. Since there is the intrasectoral transaction between crude petroleum and petroleum refining sectors the total output of petroleum products production was estimated as the sum of the output of crude petroleum and petroleum refining after subtracting the intrasectoral consumption between these two sectors. The petroleum product price was obtained by dividing the dollar value of total output of petroleum products by the total physical quantity of crude petroleum. This price reflects the average petroleum product price paid by other processing sectors for their petroleum products inputs.

The dollar value of petroleum products consumption of each processing sector was obtained by multiplying this price by the physical quantity of petroleum products used. Then the row technical coefficients were obtained by dividing the value of petroleum products consumption by the corresponding total sector output. The column technical coefficients of petroleum product production were derived in the same manner as other processing sectors.

Trade Matrix

Current data on interregional trade flows are not available. The only published data on interregional trade is Rogers, State Estimates of Interregional Commodity Trade, 1963 (91). The trade flow estimates for 61 industries among 51 regions are available in the format presented in Figure 4.1. There exist region-by-commodity trade data for each state. Regional transfers-out are treated as intraregional shipments in the trade matrices. These trade data were disaggregated to correspond with 81 industries and two regions of this model.

Column totals are total regional consumption. Trade coefficients are computed by dividing the j^{th} commodity flow from region k to region m by total regional consumption of commodity j in region m. The trade coefficients include intraregional flows. For the two region interregional trade model, a total of four diagonal matrices were computed as the following:

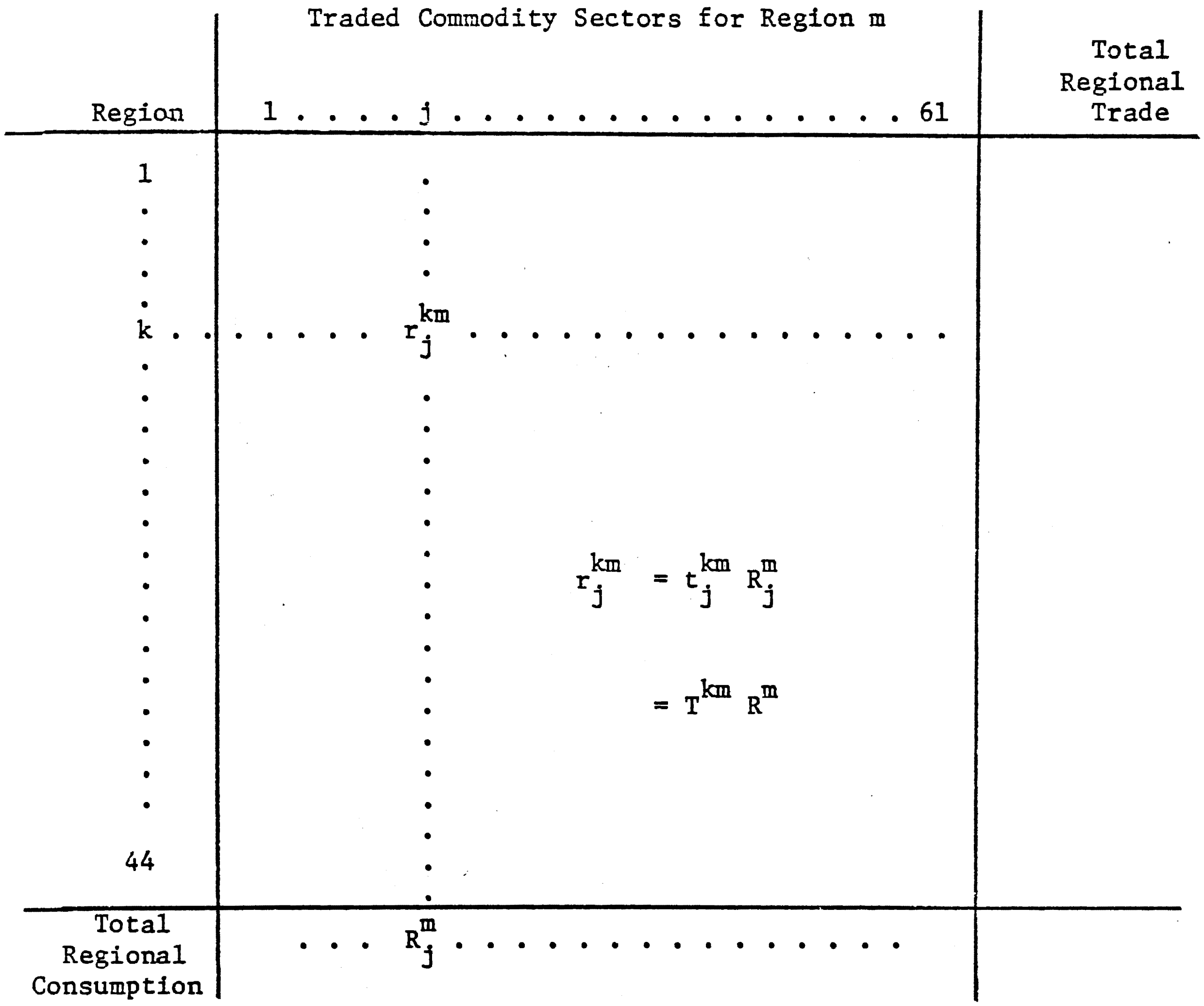


Figure 1. Region - by - Commodity Trade Data, 1963 ($1,000)

$$T = \begin{array}{cc} & \begin{array}{cc} \text{OK} & \text{RUS} \end{array} \\ \begin{array}{c} \text{OK} \\ \text{RUS} \end{array} & \left[\begin{array}{c:c} T^{11} & T^{12} \\ \hdashline T^{21} & T^{22} \end{array}\right] \end{array} \tag{4.2}$$

Each of the T^{km} matrices is an 81 sector diagonal matrix. The matrices forming the principle diagonal identify intraregional shipments, thus non-traded commodities are accounted for in these matrices. In the off-diagonal matrices, non-traded commodities (sectors 63 through 77) received a zero value.

In order to utilize these published trade data for the present study, it is necessary to assume that the interregional trade structure remained constant throughout the period between 1963 to 1977. This is one of the weaknesses of the interregional model in this study. However, attempts were made to update these data. For the non-energy processing sectors (sectors 1 through 77) interregional trade coefficients were estimated from Rodger's data. Interregional trade coefficients for energy processing sectors (sectors 78 through 81) were estimated from the current data on energy balances for Oklahoma and the Rest of U.S. for 1977 as explained in Chapter VI. The trade data of Rest of U.S. region were estimated as differences between Oklahoma and U.S. trade volume. Data for the four trade matrices are presented in Table X.

Interregional Input-Output Matrix

The interregional input-output coefficient matrices are now computed as the product of the interregional trade matrix and the regional technology matrix:

TABLE X

OKLAHOMA-REST OF U.S. TRADE COEFFICIENTS

Input-Output Sector	OK-OK	RUS-OK	OK-RUS	RUS-RUS
1. Livestock and livestock products	0.27945	0.72055	0.01848	0.98152
2. Crops and other agricultural products	0.53898	0.46102	0.00973	0.99027
3. Forestry and fishery products	1.00000	0.00000	0.00000	1.00000
4. Agricultural, forestry and fishery services	1.00000	0.00000	0.00000	1.00000
5. Iron and ferroalloy ores mining	0.00000	1.00000	0.00000	1.00000
6. Nonferrous metal ores mining	0.07855	0.92145	0.00029	0.99971
7. Stone and clay mining and quarrying	0.76218	0.23782	0.00071	0.99929
8. Chemical and fertilizer mineral mining	0.00540	0.99460	0.00000	1.00000
9. New construction	1.00000	0.00000	0.00000	1.00000
10. Maintenance and repair construction	1.00000	0.00000	0.00000	1.00000
11. Ordnance and accessories	0.46701	0.53299	0.00597	0.99403
12. Food and kindred products	0.33241	0.66759	0.00459	0.99541
13. Tobacco manufacturers	0.00000	1.00000	0.00000	1.00000
14. Broad and narrow fabrics, yarn and thread mills	0.02665	0.97335	0.00007	0.99993
15. Miscellaneous fabricated textile products	0.00497	0.99503	0.00014	0.99986
16. Apparel	0.02876	0.97124	0.00235	0.99765
17. Miscellaneous fabricated textile products	0.00817	0.99183	0.00126	0.99874
18. Lumber and wood products, except containers	0.05292	0.94708	0.00249	0.99751
19. Wood containers	0.00047	0.99530	0.000230	0.99977
20. Household furniture	0.01945	0.98055	0.002720	0.99728
21. Other furniture and fixtures	0.03149	0.96851	0.002510	0.99749
22. Paper and allied products, except containers and boxes	0.00973	0.99027	0.000980	0.99902

TABLE X (Continued)

Input-Output Sector	OK-OK	RUS-OK	OK-RUS	RUS-RUS
23. Paperboard containers and boxes	0.02009	0.97991	0.003310	0.99669
24. Printing and publishing	0.37098	0.62902	0.00175	0.99825
25. Chemicals and selected chemical products	0.12368	0.87632	0.00271	0.99729
26. Plastics and synthetic materials	0.00395	0.99605	0.00088	0.99912
27. Drugs, cleaning and toilet preparations	0.00736	0.99264	0.00079	0.99921
28. Paints and allied products	0.00271	0.99729	0.00242	0.99758
29. Paving and roofing materials	0.73880	0.26120	0.00220	0.99780
30. Rubber and miscellaneous plastic products	0.13464	0.86536	0.00898	0.99102
31. Leather tanning and finishing	0.08744	0.91256	0.00000	1.00000
32. Footwear and other leather products	0.00793	0.99207	0.00119	0.99881
33. Glass and glass products	0.40060	0.59940	0.01946	0.98054
34. Stone and clay products	0.60568	0.39432	0.00164	0.99836
35. Primary iron and steel manufacturing	0.06925	0.93075	0.00071	0.99929
36. Primary nonferrous metals manufacturing	0.13305	0.86695	0.00488	0.99512
37. Metal containers	0.01311	0.98689	0.00128	0.99872
38. Heating, plumbing, and fabricated structural metal products	0.54206	0.45794	0.00991	0.99009
39. Screw machine products and stampings	0.01712	0.98288	0.00140	0.99860
40. Other fabricated metal products	0.38843	0.61157	0.00350	0.99650
41. Engines and turbines	0.03975	0.96025	0.00158	0.99842
42. Farm and garden machinery	0.02683	0.97317	0.00243	0.99757
43. Construction and mining machinery	0.14682	0.85318	0.02660	0.97340
44. Materials handling machinery and equipment	0.02558	0.97442	0.00275	0.99725
45. Metal working machinery and equipment	0.00013	0.99987	0.01414	0.98586
46. Special industry machinery and equipment	0.00761	0.99239	0.00273	0.99727

TABLE X (Continued)

Input-Output Sector	OK-OK	RUS-OK	OK-RUS	RUS-RUS
47. General industry machinery and equipment	0.02854	0.97146	0.00974	0.99026
48. Miscellaneous machinery, except electrical	0.03025	0.96975	0.00554	0.99446
49. Office, computing, and accounting machines	0.05585	0.99415	0.00041	0.99959
50. Service industry machines	0.08061	0.91939	0.00497	0.99503
51. Electrical transmission and distribution equipment and industrial apparatus	0.02624	0.97376	0.00282	0.99718
52. Household appliances	0.00315	0.99685	0.00089	0.99911
53. Electric lighting and wiring equipment	0.01078	0.98922	0.00043	0.99947
54. Radio, TV and communication equipment	0.10724	0.89276	0.01210	0.98790
55. Electronic components and accessories	0.00628	0.99372	0.00200	0.99800
56. Miscellaneous electrical machinery, equipment and supplies	0.01711	0.98289	0.00278	0.99722
57. Motor vehicles and equipment	0.02401	0.97599	0.00143	0.99857
58. Aircraft and parts	0.47413	0.52587	0.02215	0.99785
59. Other transportation equipment	0.04020	0.95980	0.00278	0.99722
60. Professional, scientific and controlling instruments and supplies	0.14848	0.85152	0.00215	0.99785
61. Optical, ophthalmic, and photographic equipment and supplies	0.00091	0.99909	0.00034	0.99966
62. Miscellaneous manufacturing	0.11948	0.88052	0.00146	0.99854
63. Transportation and warehousing	1.00000	0.00000	0.00000	1.00000
64. Communications, except radio and TV	1.00000	0.00000	0.00000	1.00000
65. Radio and TV broadcasting	1.00000	0.00000	0.00000	1.00000
66. Water supply and sanitary services	1.00000	0.00000	0.00000	1.00000
67. Wholesale and retail trade	1.00000	0.00000	0.00000	1.00000

TABLE X (Continued)

Input-Output Sector	OK-OK	RUS-OK	OK-RUS	RUS-RUS
68. Finance and insurance	1.00000	0.00000	0.00000	1.00000
69. Real estate and rental	1.00000	0.00000	0.00000	1.00000
70. Hotels and lodging, personal and repair services (except auto)	1.00000	0.00000	0.00000	1.00000
71. Business services	1.00000	0.00000	0.00000	1.00000
72. Eating and drinking places	1.00000	0.00000	0.00000	1.00000
73. Automobile repair and services	1.00000	0.00000	0.00000	1.00000
74. Amusements	1.00000	0.00000	0.00000	1.00000
75. Health, educational and social services and nonprofit organizations	1.00000	0.00000	0.00000	1.00000
76. Federal government enterprises	1.00000	0.00000	0.00000	1.00000
77. State and local government enterprises	1.00000	0.00000	0.00000	1.00000
78. Petroleum products production	1.00000	0.00000	0.01120	0.98800
79. Natural gas production	1.00000	0.00000	0.05336	0.94664
80. Coal mining	1.00000	0.00000	0.00852	0.99148
81. Electricity and hydropower	1.00000	0.00000	0.00612	0.99388

$$\left[\begin{array}{c|c} T^{11} & T^{12} \\ \hline T^{21} & T^{22} \end{array}\right] \cdot \left[\begin{array}{c|c} A^{OK} & 0 \\ \hline 0 & A^{RUS} \end{array}\right] = \left[\begin{array}{c|c} B^{11} & B^{12} \\ \hline B^{21} & B^{22} \end{array}\right] \tag{4.3}$$

or

$$T \quad \cdot \quad A \quad = \quad B$$

Interregional flows can be computed as the product of the B matrix and the diagonal matrix of regional output:

$$\left[\begin{array}{c|c} B^{11} & B^{12} \\ \hline B^{21} & B^{22} \end{array}\right] \cdot \left[\begin{array}{c|c} X^{OK} & 0 \\ \hline 0 & X^{RUS} \end{array}\right] = \begin{array}{c} OK \\ RUS \end{array} \left[\begin{array}{c|c} X^{11} & X^{12} \\ \hline X^{21} & X^{22} \end{array}\right] \tag{4.4}$$

The interregional input-output coefficient matrix and the 1977 interregional interindustry flow matrix are not presented in this study.

The complete interregional input-output model can now be expressed as:

$$\left[\begin{array}{c|c} B^{11} & B^{12} \\ \hline B^{21} & B^{22} \end{array}\right] \left[\begin{array}{c} X^{OK} \\ \hline X^{RUS} \end{array}\right] + \left[\begin{array}{c|c} T^{11} & T^{12} \\ \hline T^{21} & T^{22} \end{array}\right] \left[\begin{array}{c} Y^{OK} \\ \hline Y^{RUS} \end{array}\right] = \left[\begin{array}{c} X^{OK} \\ \hline X^{RUS} \end{array}\right] \tag{4.5}$$

or

$$B \quad \cdot \quad X \quad + \quad T \quad\quad Y \quad = \quad X$$

The elements B, X and T are previously defined. Final demand, Y, when multiplied by the interregional trade coefficient matrix shows those portions of final demand coming from each region.

The output projection equation becomes:

$$X = (I-B)^{-1}\ TY \tag{4.6}$$

The interregional direct and indirect input-output coefficient matrix, $(I-B)^{-1}$, is used for the economic impact analysis in the latter parts of this study. The 1977 interregional direct and indirect input-output coefficient matrix is not presented in this study due to its size.

CHAPTER V

REGIONAL EMPLOYMENT AND INCOME ACCOUNT

The human resource account presents the data of regional employment and income for the purpose of economic impact analysis. Included in this account are estimates of wage and salary and proprietor employment by input-output sector. With employment and sector output data, employment-output coefficients are developed for 81 processing sectors for Oklahoma and Rest of U.S. The income portion of the account includes wage and salary disbursements and proprietors' income by input-output sector. The income-output coefficients are also estimated in this account. This chapter is presented in two sections; employment analysis and income analysis.

Employment Analysis

Employment Data

Data of Oklahoma labor force and employment were obtained from two sources. Agricultural sector employment data were obtained from Oklahoma Department of Agriculture, Oklahoma Agricultural Statistics, 1980 (77). This data source provides total farm employment and family and hired workers. The Oklahoma employment was from Oklahoma Employment Security Commission, Handbook of Oklahoma Employment, 1981 (80) and provides data on total employment, number of proprietors and estimates of domestic service, self-employed, and unpaid family workers for the non-agricultural sectors. The Oklahoma Employment Security Commission (81) also provides data on the number of nonfarm wage and salary jobs by industry.

Data for Rest of U.S. employment were obtained from the U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings (130). This data source provides number and employment status of the noninstitutional population 16 years and over in the U.S. from 1970 to 1980. However, estimates of wage and salary employment are available only by relatively broad sector categories.

Structure of the U.S. labor force from 1970 to 1980 is presented in Table XI. Total labor force has increased continuously from 82,715,000 in 1970 to 104,719,000 in 1980 or about 26.6 percent increase. Number of persons employed increased from 78,627,000 in 1970 to 92,270,000 in 1980, an increase of 17.4 percent. Rapid increase in total employment was mainly the result of sharp increases in employment of non-agricultural sectors. Non-agricultural sector employment was 75,165,000 in 1970, and 93,960,000 in 1980, or a 25.0 percent incresae. Employment in agriculture remains fairly stable with a slight decline in recent years. Agricultural employment was 3,462,000 in 1970, and 3,310,000 in 1980, or 4.4 percent decline. The number of unemployed reflects two separate business cycles over the 11 year period.

General characteristics of the Oklahoma labor force from 1970 to 1980 are presented in Table XII. Similar to the national trend, the Oklahoma labor force showed a continuous increase over the period.

TABLE XI

U.S. CIVILIAN LABOR FORCE 1970-1980
(IN THOUSANDS)

Year	Employment		Total Employed	Unemployed	Total Civilian Labor Force
	Agriculture	Nonagriculture			
1970	3,462	75,165	78,627	4,088	82,715
1971	3,387	75,732	79,120	4,993	84,113
1972	3,472	78,230	81,702	4,840	86,542
1973	3,452	80,957	84,409	4,304	88,714
1974	3,492	82,443	85,935	5,076	91,011
1975	3,380	81,403	84,783	7,830	92,613
1976	3,297	84,188	87,485	7,288	94,773
1977	3,244	87,302	90,546	6,855	97,401
1978	3,342	91,031	94,373	6,047	100,420
1979	3,297	93,648	96,945	5,963	102,908
1980	3,310	93,960	92,270	7,448	104,719

Source: U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1981.

TABLE XII

OKLAHOMA LABOR FORCE 1970-80
(IN THOUSANDS)

Year	Wage and Salary Employment	Proprietor Employment Agriculture[a]	Non-Agriculture	Total	Total Employed	Unemployed[b]	Total Labor Force
1970	787.5	99.5	130.5	230.0	1,017.5	41.0	1,058.5
1971	795.8	98.7	133.2	231.9	1,027.7	41.0	1,068.7
1972	832.2	96.7	134.6	231.3	1,063.5	44.0	1,107.5
1973	869.2	95.3	134.2	229.5	1,098.7	33.0	1,131.7
1974	896.9	93.9	136.5	230.4	1,127.3	49.0	1,176.3
1975	903.4	89.0	140.1	229.1	1,132.5	83.0	1,215.5
1976	949.9	84.5	141.6	226.1	1,176.0	65.0	1,241.0
1977	992.0	75.3	149.5	224.8	1,216.8	61.0	1,277.8
1978	1,051.3	82.5	157.0	239.5	1,290.8	48.0	1,338.8
1979	1,105.6	61.8	161.5	233.3	1,328.9	44.0	1,372.9
1980	1,152.3	55.5	165.6	221.1	1,373.4	64.0	1,437.4

[a]Include family workers in agriculture.

[b]Include those idled or unemployed as a result of labor dispute.

Sources: Oklahoma Department of Agriculture, Oklahoma Agricultural Statistics, 1980.
Oklahoma Employment Security Commission, Handbook of Oklahoma Employment, 1980.

Total labor force in Oklahoma increased from 1,058,500 in 1970 to 1,437,400 in 1980, a 35.8 percent increase. Total employment increased from 1,017,500 in 1970 to 1,373,400 in 1980, a 35.0 percent increase. Total employement in Oklahoma is composed of wage and salary employment and proprietor employment. Wage and salary employment made dramatic change through the years. Wage and salary increased from 787,500 in 1970 to 1,152,300 in 1980 or 46.3 percent increase. The share of wage and salary employment in total employment increased from 77.4 percent in 1970 to 83.9 percent in 1980. Total proprietor employment is composed of self-employed and unpaid family workers in agriculture and non-agricultural industry and related services. Total proprietor employment declined from 230,000 in 1970 to 221,100 in 1980. The decline in total proprietor employment is related to the continuous drop in the proprietor employment in agriculture. Proprietor employement in agriculture decreased from 99,500 or 43.3 percent of total proprietor employment in 1970 to 55,500 or 25.7 percent of total proprietor employment in 1980, a 44.2 percent decline. Proprietor employment in non-agriculture increased from 130,500 in 1970 to 165,600 in 1980, a 26.9 percent increase. The number of unemployed increased from 41,000 in 1970 to 83,000 in 1975, decreased to 44,000 in 1979 and increased again to 64,000 in 1980. In 1977, total employment in Oklahoma was 1,216,800. It was composed of 992,000 of wage and salary employment and 224,800 of proprietor employment.

Employment By Input-Output Sector

To further disaggregate the employment data into 81 input-output industrial classifications, the following procedures were used. Data from the Oklahoma Department of Agriculture (78) were used to allocate farm employment to the four agricultural sectors assuming that the percentage distribution of employment among those four agricultural sectors are the same as those estimated by Schreiner et al. (95). Employment payroll data from the Oklahoma Employment Security Commission (80) were used to allocate nonfarm wage and salary employment to the nonagricultural input-output sectors. Proprietor employment distributed to input-output industry groupings, computed by Schreiner et al. (95) was used to disaggregate the 1977 proprietor employment of Oklahoma. Finally, the sum of wage and salary employment and proprietor employment provided the allocation of total employment by 81 input-output sectors for Oklahoma in 1977. The allocation of U.S. employment data among input-output sectors as computed by Schreiner et al. (95) was used to disaggregate 1977 U.S. total employment into the 81 processing sectors. Subtraction of Oklahoma employment from U.S. employment gives the final allocation of Rest of U.S. total employment among the 81 input-output sectors.

Estimates of 1977 total employment by input-output sectors for Oklahoma, Rest of U.S., and U.S. are presented in Table XIII. In 1977, total employment in Oklahoma and Rest of U.S. was 1,216,800 and 89,329,200, respectively. Total interindustry employment was 999,383 or 82.2 percent of total employment in Oklahoma and 77,950,518 or 87.3 percent of total employment in Rest of U.S. Processing sectors with high pecentage share of total employment are mainly those dealing with

TABLE XIII

WAGE AND SALARY AND PROPRIETORS' EMPLOYMENT
BY INPUT-OUTPUT SECTOR, 1977

Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
1. Livestock and livestock products	56,260	1,360,550	1,416,810
2. Crops and other agricultural products	52,042	1,397,170	1,449,212
3. Forestry and fishery products	549	133,333	133,882
4. Agricultural, forestry and fishery services	5,968	238,128	244,096
Agriculture, forestry and fisheries	114,819	3,129,181	3,244,000
5. Iron and ferroalloy ores mining	0	18,856	18,856
6. Nonferrous metal ores mining	186	37,654	37,840
7. Stone and clay mining and quarrying	1,831	91,463	93,294
8. Chemical and fertilizer mineral mining	1	23,943	23,944
Mining except fuels	2,018	171,196	173,934
9. New construction	58,553	3,220,194	3,278,747
10. Maintenance and repair construction	7,896	1,039,605	1,047,501
Construction	66,449	4,259,799	4,326,248
11. Ordnance and accessories	514	56,486	57,000
12. Food and kindred products	16,580	1,669,842	1,686,422
13. Tobacco manufactures	0	78,400	78,400
14. Broad and narrow fabrics, yarn and thread mills	636	782,798	783,434
15. Miscellaneous textile goods and floor coverings	1,773	132,508	134,281
16. Apparel	9,456	1,118,042	1,127,498
17. Miscellaneous fabricated textile products	1,364	190,532	191,896
18. Lumber and wood products, except containers	4,620	725,990	730,610
19. Wood containers	133	43,464	43,597
20. Household furniture	1,869	330,324	332,193
21. Other furniture and fixtures	671	156,341	157,012
22. Paper and allied products, except containers	1,573	481,927	483,500
23. Paperboard containers and boxes	992	213,008	214,000
24. Printing and publishing	10,488	1,176,172	1,186,660
25. Chemicals and selected chemical products	1,610	482,228	483,838

TABLE XIII (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
26.	Plastics and synthetic materials	637	212,070	212,707
27.	Drugs, cleaning and toilet preparations	214	310,449	310,663
28.	Paints and allied products	351	66,316	66,667
29.	Paving and roofing materials	497	30,429	30,926
30.	Rubber and miscellaneous plastic products	9,770	723,684	733,454
31.	Leather tanning and finishing	73	22,885	22,958
32.	Footwear and other leather products	718	230,169	230,887
33.	Glass and glass products	4,766	199,873	204,639
34.	Stone and clay products	5,487	474,178	479,665
35.	Primary iron and steel manufacturing	2,648	470,545	473,193
36.	Primary nonferrous metal manufacturing	2,352	400,911	403,263
37.	Metal containers	174	73,834	74,008
38.	Heating, plumbing and structural metal products	13,675	548,571	562,246
39.	Screw machine products and stamping	1,264	402,961	404,225
40.	Other fabricated metal products	5,339	523,901	529,240
41.	Engines and turbines	104	132,138	132,242
42.	Farm and garden machinery	1,065	165,038	166,103
43.	Construction and mining machinery	11,762	290,850	302,612
44.	Materials handling machinery and equipment	605	65,244	65,849
45.	Metal working machinery and equipment	264	337,609	337,873
46.	Special industry machinery and equipment	1,017	196,063	197,080
47.	General industrial machinery and equipment	5,640	299,662	305,302
48.	Misc. machinery, except electrical	3,068	255,707	258,775
49.	Office, computing and accounting machines	3,499	330,894	334,393
50.	Service industry machines	1,845	178,702	180,547
51.	Electric industrial equipment and apparatus	1,544	357,330	358,874
52.	Household appliances	77	185,530	185,607
53.	Electric lighting and wiring equipment	225	211,193	211,418
54.	Radio, TV, and communication equipment	9,759	120,148	129,907
55.	Electronic components and accessories	854	409,257	410,111

TABLE XIII (Continued)

Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
56. Misc. electrical machinery and supplies	266	156,166	156,432
57. Motor vehicles and equipment	3,461	989,979	993,440
58. Aircraft and parts	6,061	476,584	482,645
59. Other transportation equipment	2,552	440,740	443,292
60. Scientific and controlling instruments	695	276,522	277,217
61. Optical, ophthalmic and photo equipment	452	357,048	357,500
62. Miscellaneous manufacturing	2,524	448,103	450,627
Manufacturing	157,583	19,009,345	19,166,928
63. Transportation and warehousing	37,969	2,957,490	2,995,459
64. Communications, except radio and TV	11,574	1,012,460	1,024,034
65. Radio and TV broadcasting	1,851	170,473	172,324
Transportation, communication and utilities	52.199	4,373,155	4,425,354
66. Water supply and sanitary services	805	232,732	233,537
67. Wholesale and retail trade	268,321	16,281,519	16,549,840
68. Finance and insurance	42,956	3,852,548	3,895,504
69. Real estate and rental	11,892	1,143,861	1,155,753
Finance, insurance and real estate	54,848	4,996,409	5,051,257
70. Hotels, personal and repair service except auto	33,655	2,176,483	2,210,138
71. Business services	41,954	2,940,969	2,982,923
72. Eating and drinking places	43,087	4,257,936	4,301,023
73. Automobile repair and services	6,890	712,418	719,308
74. Amusements	8,883	711,709	720,592
75. Health, educational and social services and nonprofit org.	76,372	8,364,223	8,440,595
Services	210,841	19,163,738	19,374,579
76. Federal government enterprises	5,268	364,732	370,000
77. State and local government enterprises	3,946	470,054	474,000
Government enterprises	9,214	834,786	844,000

TABLE XIII (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
78.	Petroleum products production	26,546	462,069	488,615
79.	Natural gas production	29,595	272,650	302,245
80.	Coal mining	610	84,119	84,729
81.	Electricity and hydropower	6,885	341,838	348,723
Energy producing		63,636	1,160,676	1,224,312
	Total Interindustry	999,928	73,380,524	78,380,452
	Private Household	16,886	5,780,662	5,797,548
	Federal Government	43,232	2,310,768	2,354,000
	State and Local Government	156,754	7,857,246	8,014,000
	Total Employment	1,216,800	89,329,200	90,546,000

Sources: Oklahoma Department of Agriculture, Oklahoma Agricultural Statistics, 1980.

Oklahoma Employment Security Commission, Handbook of Oklahoma Employment, 1980.

U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1981.

service related activities. They include: wholesale and retail trade (sector 67); health, educational, and social services and nonprofit orgainizations (sector 75); eating and drinking places (sector 72); finance and insurance (sector 68); business services (sector 71); and hotels, personal and repair services except auto (sector 70). Oklahoma employment in these sectors as a percent of total employment ranged from 22.1 percent for wholesale and retail trade (sector 67) to 2.8 percent for hotels, personal and repair services except auto (sector 70). For the Rest of U.S., the range was from 18.2 percent for wholesale and retail trade and 2.4 percent for hotels, personal and repair services except auto.

Federal government (including federal government enterprise) employed 48,500 or 4.0 percent of total employment in Oklahoma and 2,675,500 or 3.0 percent of total employment in Rest of U.S. State and local government (including state and local government enterprise) employed 160,700 or 13.2 percent of total employment in Oklahoma and 8,327,300 or 9.3 percent of total employment in Rest of U.S.

New construction (sector 9) employed 58,553 or 4.8 percent of total employment in Oklahoma and 3,220,194 or 3.6 percent of total employment in Rest of U.S., respectively. Transportation and warehousing (sector 63) employed 37,969 or 3.1 percent of total employment in Oklahoma and 2,957,490 or 3.3 percent of total employment in Rest of U.S.

Food and kindred products (sector 12) has the highest percentage share of employment of any manufacturing industry. Food and kindred products employed 16,580 or 1.4 percent of total employment in Oklahoma and 1,669,842 or 1.9 percent of total employment in Rest of U.S.

Among energy processing sectors, petroleum products and natural gas production were leaders in employment. Petroleum products (sector 78) employed 26,546 or 2.2 percent of total employment in Oklahoma and 462,069 or 0.5 percent of total employment in Rest of U.S. Natural gas production (sector 79) employed 29,595 or 2.4 percent of total employment in Oklahoma and 272,650 or 0.3 percent of total employment in Rest of U.S.

Livestock and livestock products (sector 1) employed 56,260 or 4.6 percent of total employment in Oklahoma and 1,360,550 or 1.5 percent of total employment in Rest of U.S. Crops and other agricultural products (sector 2) employed 52,042 or 4.3 percent of total employment in Oklahoma and 1,397,170 or 1.6 percent of total employment in Rest of U.S.

Employment-Output Coefficients

Employment-output coefficients are needed for estimating direct employment effects from a one unit increase in sector output. Employment-output coefficients indicate average labor productivity of the processing sectors. Estimates of 1977 employment-output coefficients by input-output sector for Oklahoma and Rest of U.S. are presented in Table XIV. These coefficients were obtained by dividing total employment by input-output sector by the corresponding sector total output from Table VIII of Chapter IV. The employment-output coefficient shows direct employment requirement per thousand dollars of output in the particular sector.

TABLE XIV

EMPLOYMENT OUTPUT COEFFICIENTS, 1977
(PERSONS EMPLOYED PER $1,000
OUTPUT IN 1977 PRICES)

	Input-Output Sector	Oklahoma	Rest of U.S.
1.	Livestock and livestock products	0.03408	0.02173
2.	Crops and other agricultural products	0.04875	0.01647
3.	Forestry and fishery products	0.02161	0.03861
4.	Agricultural, forestry and fishery services	0.04901	0.01834
5.	Iron and ferroalloy ores mining	--	--
6.	Nonferrous metal ores mining	0.02673	0.01065
7.	Stone and clay mining and quarrying	0.01270	0.02069
8.	Chemical and fertilizer mineral mining	0.00009	0.01111
9.	New construction	0.03012	0.01802
10.	Maintenance and repair construction	0.01867	0.03081
11.	Ordnance and accessories	0.03435	0.00547
12.	Food and kindred products	0.01005	0.00846
13.	Tobacco manufacturers	--	0.00679
14.	Broad and narrow fabrics, yarn and thread mills	0.01651	0.02455
15.	Miscellaneous textile goods and floor coverings	0.02236	0.01479
16.	Apparel	0.03448	0.03483
17.	Miscellaneous fabricated textile products	0.02377	0.02317
18.	Lumber and wood products, except containers	0.01799	0.01869
19.	Wood containers	0.01929	0.03575
20.	Household furniture	0.03922	0.03156
21.	Other furniture and fixutres	0.02915	0.02338
22.	Paper and allied products, except containers	0.00778	0.01239
23.	Paper board containers and boxes	0.02131	0.01595
24.	Printing and publishing	0.03042	0.02370
25.	Chemicals and selected chemical products	0.00454	0.00784
26.	Plastics and synthetic materials	0.19818	0.01048
27.	Drugs, cleaning and toilet preparations	0.01621	0.01005
28.	Paints and allied products	0.01390	0.00993
29.	Paving and roofing material	0.00811	0.00846
30.	Rubber and miscellaneous plastic products	0.01315	0.01840
31.	Leather tanning and finishing	0.01014	0.01567
32.	Footwear and other leather products	0.05757	0.03716
33.	Glass and glass products	0.02627	0.02205
34.	Stone and clay products	0.01915	0.01842
35.	Primary iron and steel manufacturing	0.01610	0.01226
36.	Primary nonferrous metal manufacturing	0.01743	0.00999
37.	Metal containers	0.01290	0.00793
38.	Heating, plumbing and structural metal products	0.01907	0.01857
39.	Screw machine products and stamping	0.03656	0.01990
40.	Other fabricated metal products	0.02075	0.01727

TABLE XIV (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.
41.	Engines and turbines	0.00316	0.01240
42.	Farm and garden machinery	0.01963	0.01396
43.	Construction and mining machinery	0.01620	0.01632
44.	Materials handling machinery and equipment	0.01876	0.01264
45.	Metal working machinery and equipment	0.01675	0.02481
46.	Special industry machinery and equipment	0.00909	0.02142
47.	General industrial machinery and equipment	0.02198	0.01805
48.	Miscellaneous machinery except electrical	0.02724	0.03140
49.	Office, computing and accounting machines	0.01614	0.01926
50.	Service industry machines	0.01944	0.01427
51.	Electric industrial equipment and apparatus	0.02564	0.02289
52.	Household appliances	0.01357	0.01705
53.	Electric lighting and wiring equipment	0.01345	0.02488
54.	Radio, TV and communication equipment	0.01487	0.00406
55.	Electronic components and accessories	0.01747	0.02612
56.	Miscellaneous electrical machinery and supplies	0.01490	0.01705
57.	Motor vehicles and equipment	0.01294	0.00827
58.	Aircrafts and parts	0.02408	0.01851
59.	Other transportation equipment	0.04086	0.02786
60.	Scientific and controlling instruments	0.01484	0.01629
61.	Optical, ophthalmic, and photo equipment	0.00633	0.02901
62.	Miscellaneous manufacturing	0.03249	0.02304
63.	Transportation and warehousing	0.02270	0.02688
64.	Communications, except radio and TV	0.02643	0.02316
65.	Radio and TV broadcasting	0.02458	0.02723
66.	Water supply and sanitary services	0.01105	0.04897
67.	Wholesale and retail trade	0.07509	0.05472
68.	Finance and insurance	0.03689	0.03463
69.	Real estate and rental	0.00412	0.00473
70.	Hotels; personal and repair services except auto	0.06353	0.04982
71.	Business services	0.07344	0.05453
72.	Eating and drinking places	0.06270	0.07024
73.	Automobile repair and services	0.02802	0.03340
74.	Amusements	0.07569	0.03385
75.	Health, educational and social services and non-profit organization	0.03828	0.03905
76.	Federal government enterprises	0.02043	0.02393
77.	State and local government enterprises	0.02061	0.02263
78.	Petroleum products production	0.00914	0.01016
79.	Natural gas production	0.02117	0.01984
80.	Coal mining	0.00575	0.00566
81.	Electricity and hydropower	0.00684	0.01544
82.	Household	0.00131	0.01317

For Oklahoma, processing sectors with the highest employment-output ratios are trade and service related activities. They include amusements (sector 74); wholesale and retail trade (sector 67); business services (sector 71); hotel, personal and repair services, except auto (sector 70); and eating and drinking places (sector 72). With a one million dollar increase in output of these sectors, employment increases by the following amounts: 76 persons for amusements; 75 persons for wholesale and retail trade; 64 persons for hotels, personal and repair services, except auto; and 63 persons for eating and drinking places. For energy processing sectors, petroleum products production and natural gas production required nine persons and 21 persons, respectively, for every one million dollar increase in value of output. Livestock and livestock products and crops and other agricultural products employed 34 persons and 49 persons for every one million dollars of output, respectively.

For Rest of U.S., sectors with the highest employment-output coefficients are similar to those of Oklahoma. Eating and drinking places (sector 72) employed 70 persons for every one million dollars of output. Wholesale and retail trade (sector 67) and business services (sector 71) required 55 persons for every one million dollars of output. Natural gas production employed 20 persons while petroleum products production employed 10 persons for every one million of output. Livestock and livestock products employed 22 persons and crops and other agricultural products employed 16 persons for every million dollars of output.

Income Analysis

Income Data

The human resource account presents an analysis of the structure of personal income in Oklahoma and U.S. for the period 1970-80. Income data were obtained from the U.S. Department of Commerce, Survey of Current Business, July 1981 (109) in broad sector categories. Total personal income is estimated by summing wages and salary disbursement; other labor income; proprietors income; dividends, interest, and rent; and transfer payments, and subtracting personal contributions to social insurance.

The structure of personal income in the U.S. between 1970-80 is presented in Table XV. Total personal income increased from $803,922 million in 1970 to $2,162,936 million in 1980. Wage and salary disbursements increased from $541,831 million in 1970 to $1,348,179 million in 1980. All other income categories also show substantial increase between 1970 to 1980. Other labor income, proprietor's income, property income (dividends, interest, and rent), and transfer payments increased about 322 percent, 95 percent, 208 percent and 267 percent, respectively, during this ten year period.

Personal income per capita is defined as total personal income divided by total population. Per capita personal income in U.S. increased from $3,945 in 1970 to $9,521 in 1980, or 141 percent increase.

TABLE XV

PERSONAL INCOME, UNITED STATES, 1970-80
(MILLION DOLLARS)

Item	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Wage and salary disbursement	541,831	574,716	629,212	696,844	760,084	800,828	884,487	977,949	1,100,827	1,231,844	1,348,179
Other labor income	32,480	36,666	43,007	48,815	55,817	64,489	75,823	88,990	102,124	118,552	137,058
Propreitor's income	65,904	69,050	76,369	93,318	88,014	90,114	95,154	105,173	117,613	131,515	128,765
Dividends, interest and rent	111,347	117,667	126,045	142,980	164,976	176,145	192,542	215,325	243,665	288,760	342,503
Transfer payments	80,149	94,435	104,681	119,512	141,221	178,308	194,273	207,472	233,272	249,392	294,240
Less: personal contributions for social insurance	27,603	30,420	34,218	42,305	47,627	50,118	55,149	60,739	69,244	80,181	87,370
Total personal income	803,922	861,904	944,852	1,058,902	1,162,203	1,259,430	1,386,772	1,533,768	1,939,486	1,939,486	2,162,936
Per capita income	3,945	4,167	4,515	5,010	5,448	5,845	6,374	6,979	8,637	8,637	9,521

Note: Sums may not add to total due to rounding.

Source: U.S. Department of Commerce, Survey of Current Business, Revised State Personal Income Data 1969-80, July 1981.

The structure of personal income in Oklahoma between 1970 and 1980 is presented in Table XVI. Total personal income increased from $8,565 million in 1970 to $27,645 million in 1980, or 222.8 percent increase. Wage and salary disbursement increased substantially from $5,307 million in 1970 to $16,279 million in 1980, or 206.7 percent increase. Almost all categories of personal income show a substantial increase every year from 1970 to 1980. Other labor income increased from $318 million in 1970 to $1,649 million in 1980. Proprietors' income increased from $949 million in 1970 to $2,400 million in 1980. However, proprietors' income declined in 1971, 1974, 1975 and 1980. Dividends, interest, and rent increased from $1,201 million in 1970 to $4,478 million in 1980. Per capita income in Oklahoma was slightly less than that for the U.S. Per capita personal income in Oklahoma increased from $3,337 in 1970 to $9,116 in 1980, or 173 percent increase.

Income by Input-Output Sector

Labor and proprietors' income was used to allocate income into 81 input-output sectors of Oklahoma and the Rest of U.S. for the purpose of economic impact analysis. Data of the Department of Commerce (109) distribute labor and proprietors' income by broad industrial classifications for both Oklahoma and U.S. from 1969 to 1980. This data source includes both wage and salary disbursement and other labor income. The 1970 payroll and proprietors' income by input-output sector of Schreiner et al. (95) was used to allocate the 1977 labor and proprietors' income for both Oklahoma and the U.S. Labor and proprietors' income by input-output sector for Rest of U.S. was obtained by subtracting Oklahoma income from that of the U.S.

TABLE XVI

PERSONAL INCOME, OKLAHOMA, 1970-80
(MILLION DOLLARS)

Item	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Wage and salary disbursement	5,307	5,636	6,148	6,812	7,674	8,432	9,420	10,597	12,197	14,003	16,279
Other labor income	318	358	424	482	574	688	810	960	1,133	1,360	1,649
Proprietor's income	949	946	1,117	1,493	1,323	1,319	1,425	1,638	2,028	2,572	2,400
Dividends, interest and rent	1,201	1,312	1,333	1,651	2,001	2,169	2,402	2,887	3,296	3,848	4,478
Transfer payments	1,019	1,176	1,290	1,484	1,777	2,193	2,423	2,615	2,820	3,197	3,687
Less: personal contributions for social insurance	284	326	353	455	498	543	602	686	802	948	1,038
Total personal income	8,565	9,158	10,024	11,542	12,954	14,398	16,051	18,158	20,824	24,207	27,645
Per capita income (dollars)	3,337	3,498	3,772	4,284	4,741	5,194	5,685	6,336	7,148	8,150	9,116

Note: Sum may not add to total due to rounding.

Source: U.S. Department of Commerce. Survey of Current Business, Revised State Personal Income 1969-80, July 1981.

The distribution of 1977 labor and proprietors' income by input-output sector for Oklahoma and Rest of U.S. are presented in Table XVII. In 1977, total labor and proprietors' income in Oklahoma was $13,195 million or 72.6 percent of total personal income. Wage and salary disbursement and other labor income was $11,557 million or 87.6 percent of total labor and proprietors' income. Total interindustry sectors generated $10,390 million or 78.7 percent of total labor and propreitors' income in Oklahoma in 1977. Federal government and state and local government has the largest share in total labor and proprietors' income with 21.9 percent, wholesale and retail trade is next with 17.4 percent. These sectors are followed by manufacturing, services, and energy processing with 15.9 percent, 14.7 percent and 11.3 percent, respectively. Construction and transportation, communication and public utilities accounted for 6.9 percent and 5.1 percent of total labor and proprietors' income, respectively. The agricultural sector accounted for 2.2 percent of total labor and proprietors' income in Oklahoma in 1977.

Total labor and proprietors' income in Rest of U.S. was $1,158,917 million or 76.5 percent of total personal income in Rest of U.S. in 1977. Wage and salary disbursement and other labor income was $1,055,382 million or 91.1 percent of total labor and proprietors' income in Rest of U.S. in 1977. Total interindustry sectors in Rest of U.S. obtained $973,835 million or 84.0 percent of total labor and proprietor income in 1977. The manufacturing sectors accounted for 25.3 percent of total labor and proprietors' income. This was followed by services, federal government and state and local government, and wholesale and retail trade, with 17.8 percent, 17.1 percent and

TABLE XVII

LABOR AND PROPRIETORS' INCOME BY INPUT-OUTPUT SECTOR, 1977 (THOUSAND DOLLARS)

Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
1. Livestock and livestock products	130,452	7,268,200	7,398,652
2. Crops and other agricultural products	115,548	20,367,800	20,483,348
3. Forestry and fishery products	3,000	964,000	967,000
4. Agriculture, forestry and fishery services	49,000	3,910,000	3,959,000
Agriculture, forestry and fisheries	298,000	32,510,000	32,808,000
5. Iron and ferroalloy ores mining	0	465,288	465,288
6. Nonferrous metal ores mining	1,221	1,194,978	1,196,199
7. Stone and clay mining and quarrying	18,773	1,478,200	1,496,973
8. Chemical and fertilizer mineral mining	6	385,534	385,540
Mining except fuels	20,000	3,524,000	3,544,000
9. New construction	805,596	59,373,533	60,179,149
10. Maintenance and repair construction	107,404	8,601,447	8,708,851
Construction	913,000	67,975,000	68,888,000
11. Ordnance and accessories	241	3,325,810	3,326,051
12. Food and kindred products	205,000	23,753,000	23,958,000
13. Tobacco manufacturers	0	1,136,000	1,136,000
14. Broad and narrow fabrics, yarn and thread mills	3,647	7,670,258	7,673,905
15. Miscellaneous textile goods and floor coverings	13,353	1,689,742	1,703,095
16. Apparel	76,194	7,992,308	8,068,502
17. Miscellaneous fabricated textile products	12,806	2,907,692	2,920,498
18. Lumber and wood products, except containers	44,977	8,983,747	9,028,724
19. Wood containers	3,023	456,253	459,276
20. Household furniture	15,320	3,393,421	3,408,741
21. Other furniture and fixtures	8,680	1,699,579	1,708,259
22. Paper and allied products, except containers	21,954	7,906,208	7,928,162
23. Paperboard containers and boxes	13,046	3,640,792	3,653,838
24. Printing and publishing	111,000	15,714,000	15,825,000

TABLE XVII (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
25.	Chemicals and selected chemical products	42,661	9,869,831	9,912,492
26.	Plastics and synthetic materials	462	4,034,456	4,034,918
27.	Drugs, cleaning and toilet preparations	4,525	4,965,754	4,970,279
28.	Paints and allied products	7,352	1,653,959	1,661,311
29.	Paving and roofing material	7,175	712,473	719,648
30.	Rubber and miscellaneous plastic products	139,000	9,767,000	9,906,000
31.	Leather tanning and finishing	12	332,375	332,387
32.	Footwear and other leather products	3,988	1,930,625	1,934,613
33.	Glass and glass products	71,494	2,640,281	2,711,775
34.	Stone and clay products	74,506	7,521,719	7,596,225
35.	Primary iron and steel manufacturing	45,486	13,447,859	13,493,345
36.	Primary nonferrous metal manufacturing	36,514	11,043,141	11,079,655
37.	Metal containers	1,490	1,408,558	1,410,048
38.	Heating, plumbing and structural metal products	224,579	7,148,598	7,373,177
39.	Screw machine products and stamping	13,348	4,318,235	4,331,583
40.	Other fabricated metal products	57,583	7,389,609	7,447,192
41.	Engines and turbines	423	2,871,643	2,872,066
42.	Farm and garden machinery	12,920	3,236,652	3,249,572
43.	Construction and mining machinery	222,365	4,421,487	4,643,852
44.	Materials handling machinery and equipment	5,446	1,894,931	1,900,377
45.	Metal working machinery and equipment	5,011	6,631,964	6,636,975
46.	Special industry machinery and equipment	17,767	3,880,717	3,898,484
47.	General industrial machinery and equipment	88,065	7,183,172	7,271,237
48.	Miscellaneous machinery, except electrical	38,293	3,704,280	3,742,573
49.	Office, computing and accounting machines	6,567	4,755,466	4,762,033
50.	Service industry machines	27,143	3,168,431	3,195,574
51.	Electric industrial equipment and apparatus	18,228	4,714,691	4,732,919
52.	Household appliances	1,932	2,234,529	2,236,461
53.	Electric lighting and wiring equipment	313	1,838,171	1,838,484
54.	Radio, TV and communication equipment	149,957	9,817,091	9,967,048

TABLE XVII (Continued)

Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
55. Electronic components and accessories	3,326	3,969,979	3,973,305
56. Miscellaneous electrical machinery and supplies	2,244	1,277,796	1,280,040
57. Motor vehicles and equipment	67,000	23,335,000	22,402,000
58. Aircrafts and parts	103,865	11,786,225	11,890,090
59. Other transportation equipment	27,135	5,977,775	6,004,910
60. Scientific and controlling instruments	12,562	6,188,853	6,201,415
61. Optical, ophthalmic and photo equipment	8,438	3,305,147	3,313,585
62. Miscellaneous manufacturing	21,000	4,999,000	5,020,000
Manufacturing	2,099,416	299,646,283	301,745,699
63. Transportation and warehousing	401,000	49,556,000	49,957,000
64. Communications, except radio and TV	221,124	20,989,969	21,211,093
65. Radio and TV broadcasting	29,876	2,528,031	2,557,907
66. Water supply and sanitary services	19,973	1,244,492	1,264,465
Transportation, communication and utilities	671,973	74,318,492	74,990,465
67. Wholesale and retail trade	2,294,000	193,028,000	195,322,000
68. Finance and insurance	513,627	50,913,416	51,427,043
69. Real estate and rental	138,373	14,509,584	14,647,957
Finance, insurance and real estate	652,000	65,423,000	66,075,000
70. Hotels; personal and repair services except auto	173,000	14,959,000	15,132,000
71. Business services	151,362	17,505,536	17,656,898
72. Eating and drinking places	94,500	19,767,627	19,862,127
73. Automobile repair and services	46,138	6,943,837	6,989,975
74. Amusements	44,000	7,900,000	7,944,000
75. Health, educational and social services and non profit org.	1,294,000	123,086,000	124,380,000
Services	1,803,000	190,162,000	191,965,000
76. Federal government enterprises	107,726	8,551,008	8,658,734
77. State and local government enterprises	42,956	7,477,852	7,520,808
Government enterprise	150,682	16,028,860	16,179,542

TABLE XVII (Continued)

Input-Output Sector	Oklahoma	Rest of U.S.	U.S.
78. Petroleum products production	549,452	13,178,659	13,728,111
79. Natural gas production	791,539	5,256,660	6,048,199
80. Coal mining	28,000	5,453,000	5,481,000
81. Electricity and Hydropower	118,861	7,330,716	7,449,577
Energy producing	1,487,852	31,219,035	32,706,887
Total Interindustry	10,389,923	973,834,670	984,224,593
Private Household	67,000	4,713,929	4,780,929
Federal Government	1,151,306	55,331,803	56,483,109
State and Local Government	1,586,771	125,036,598	126,623,369
Total Labor and Proprietors' Income	13,195,000	1,158,917,000	1,172,112,000

Source: U.S. Department of Commerce, Survey of Current Business, Revised State Personal Income 1969-80, July, 1981.

16.8 percent, respectively. Transportation, communication, and public utilities, and construction sectors accounted for 6.5 percent and 5.9 percent respectively. Energy processing sectors and agricultural sectors had 2.8 percent and 2.7 percent, respectively, of total labor and proprietor income of Oklahoma in 1977.

Income-Output Coefficients

Income-output coefficients show the direct income effect of a dollar unit change in sector total output. Income-output coefficients represent the household row coefficients of an input-output model which are used in calculating income multipliers. For example, the income-output coefficient for food and kindred products (sector 12) of 0.12423 indicates that $124.23 of household income (labor and proprietors' income) is derived from each $1,000 of that sector's output.

Estimates of 1977 income-output coefficients for the 81 input-output sectors of Oklahoma and Rest of U.S. are presented in Table XVIII. Income-output coefficients were derived by dividing total labor and proprietors' income by the corresponding sector total output. For Oklahoma, sectors with high income-output coefficients are health, educational and social services, and non-profit organization (sector 75), wholesale and retail trade (sector 67), and communications, except radio and TV (sector 64). Health, educational and social services and nonprofit organizations (sector 75) obtained 64.86 cents as income from every one dollar of output, while wholesale and retail trade (sector 67)

TABLE XVIII

INCOME OUTPUT COEFFICIENTS, 1977
(INCOME PER DOLLAR OUTPUT
IN 1977 DOLLARS)

	Input-Output Sector	Oklahoma	Rest of U.S.
1.	Livestock and livestock products	0.10825	0.11606
2.	Crops and other agricultural products	0.10825	0.24012
3.	Forestry and fishery products	0.11809	0.27916
4.	Agricultural, forestry and fishery services	0.40236	0.30111
5.	Iron and ferroalloy ores mining	--	0.23427
6.	Nonferrous metal ores mining	0.17546	0.33808
7.	Stone and clay mining and quarrying	0.13021	0.33439
8.	Chemical and fertilizer mineral mining	0.00052	0.17884
9.	New construction	0.41440	0.33219
10.	Maintenance and repair construction	0.25394	0.25491
11.	Ordnance and accessories	0.01611	0.32191
12.	Food and kindred products	0.12423	0.12030
13.	Tobacco manufacturers	--	0.09839
14.	Broad and narrow fabrics, yarn and thread mills	0.09465	0.24060
15.	Miscellaneous textile goods and floor coverings	0.16839	0.18860
16.	Apparel	0.27779	0.24897
17.	Miscellaneous fabricated textile products	0.22312	0.35360
18.	Lumber and wood products, except containers	0.17511	0.23127
19.	Wood containers	0.43843	0.37530
20.	Household furniture	0.32145	0.32422
21.	Other furniture and fixtures	0.37710	0.25418
22.	Paper and allied products, except containers	0.10852	0.20328
23.	Paper board containers and boxes	0.28029	0.27264
24.	Printing and publishing	0.32196	0.31663
25.	Chemicals and selected chemical products	0.12034	0.16095
26.	Plastics and synthetic materials	0.14375	0.19946
27.	Drugs, cleaning and toilet preparations	0.34270	0.16083
28.	Paints and allied products	0.29118	0.24768
29.	Paving and roofing material	0.11715	0.19689
30.	Rubber and miscellaneous plastic products	0.18709	0.24839
31.	Leather tanning and finishing	0.00167	0.22759
32.	Footwear and other leather products	0.31976	0.31173
33.	Glass and glass products	0.39388	0.29130
34.	Stone and clay products	0.26009	0.29216
35.	Primary iron and steel manufacturing	0.27655	0.21402
36.	Primary nonferrous metal manufacturing	0.27054	0.27514
37.	Metal containers	0.11045	0.15124
38.	Heating, plumbing and structural metal products	0.31312	0.24194
39.	Screw machine products and stamping	0.38603	0.21328

TABLE XVIII (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.
40.	Other fabricated metal products	0.22379	0.24360
41.	Engines and turbines	0.01284	0.26954
42.	Farm and garden machinery	0.23816	0.27371
43.	Construction and mining machinery	0.30623	0.24810
44.	Materials handling machinery and equipment	0.16889	0.36702
45.	Metal working machinery and equipment	0.31802	0.48746
46.	Special industry machinery and equipment	0.15885	0.42398
47.	General industrial machinery and equipment	0.34327	0.43269
48.	Miscellaneous machinery, except electrical	0.34001	0.45494
49.	Office, computing and accounting machines	0.03030	0.27681
50.	Service industry machines	0.28598	0.25294
51.	Electric industrial equipment and apparatus	0.30262	0.30205
52.	Household appliances	0.34038	0.20536
53.	Electric lighting and wiring equipment	0.01871	0.21656
54.	Radio, TV and communication equipment	0.22857	0.33160
55.	Electronic components and accessories	0.06805	0.25337
56.	Miscellaneous electrical machinery and supplies	0.12572	0.13948
57.	Motor vehicles and equipment	0.25047	0.18657
58.	Aircrafts and parts	0.41269	0.45770
59.	Other transportation equipment	0.43441	0.37782
60.	Scientific and controlling instruments	0.26814	0.36501
61.	Optical, ophthalmic, and photo equipment	0.12383	0.26855
62.	Miscellaneous manufacturing	0.27036	0.25707
63.	Transportation and warehousing	0.23972	0.45169
64.	Communications, except radio and TV	0.50498	0.48023
65.	Radio and TV broadcasting	0.39667	0.40386
66.	Water supply and sanitary services	0.27426	0.26185
67.	Wholesale and retail trade	0.64197	0.64874
68.	Finance and insurance	0.44112	0.45761
69.	Real estate and rental	0.04790	0.05995
70.	Hotels; personal and repair services except auto	0.32656	0.34240
71.	Business services	0.26496	0.32460
72.	Eating and drinking places	0.13751	0.32609
73.	Automobile repair and services	0.18764	0.32555
74.	Amusements	0.37493	0.37573
75.	Health, educational and social services and non-profit organizations	0.64859	0.58724
76.	Federal government enterprises	0.41768	0.56101
77.	State and local government enterprises	0.22432	0.36000
78.	Petroleum products production	0.18931	0.28984
79.	Natural gas production	0.56619	0.38254
80.	Coal mining	0.26402	0.36684
81.	Electricity and hydropower	0.11804	0.33115

and communications, except radio and TV (Sector 64), derived 64.20 cents and 50.50 cents from every one dollar of output, respectively. Among energy processing sectors, petroleum products production, natural gas production, coal production, and electricity and hydropower derived incomes of 18.93 cents, 56.62 cents, 26.40 cents and 11.80 cents, respectively for every one dollar of output. Livestock and livestock products and crop and other agricultural products derived 10.83 cents from every one dollar of output.

For Rest of U.S., wholesale and retail trade had the highest income-output coefficient. Wholesale and retail trade (sector 67) obtained 64.87 cents of household income for each dollar of output. This was followed by health, educational and social services and nonprofit organizations, and federal government enterprise with 58.72 cents and 56.10 cents respectively. Among energy processing sectors in Rest of U.S., petroleum products production and natural gas production had the income-output ratios with 28.98 cents and 38.25 cents for every one dollar of output, respectively. Coal mining and electricity and hydropower obtained 36.68 cents and 33.12 cents as income out of every one dollar of output, respectively.

CHAPTER VI

THE REGIONAL AND INTERREGIONAL ENERGY ACCOUNT

Oklahoma has relatively abundant energy resources, primarily petroleum and natural gas. Energy development has been a key factor in the economic and social development of the state. Events during the decade of the 70's appeared to have shifted the U.S. economy from a position of abundant, low-cost energy to an outlook of possible energy shortages and rising energy prices. These events dramatically demonstrated that fossil energy reserves, including those in Oklahoma, are finite and must be husbanded with wisdom and concern for the future.

Oklahoma's position as a major net exporter of oil and gas lends importance to current and future energy policy decisions. Higher energy prices, however, cut both ways. Future revenues to producers and to the state and future costs to energy users in the state increase the importance of good information on which to make policy decisions.

The objective of this chapter is to construct an energy account for Oklahoma in a form easily integrated into an interregional input-output model for the purpose of evaluating the effects of changes in energy prices on other regional commodity prices and on all input-output multipliers. The major contribution of the energy account is its estimated distribution of energy utilization by input-output sector and basic energy source, thus recasting energy statistics into a form consistent with economic models composed of processing and final demand sectors. In this study energy sources are classified as natural gas, petroleum products (including gasoline, heating fuels, non-gasoline transportation fuels and products employed in industrial processing, energy-production and miscellaneous uses), coal and electricity.

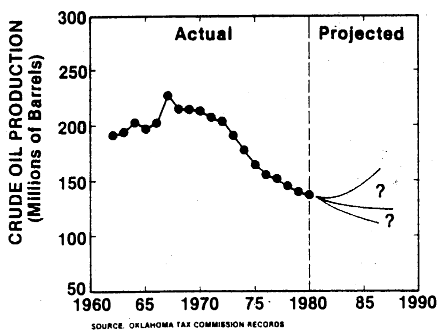
This chapter is organized into two sections. The first section discusses the trends in energy production, consumption, trade and prices in Oklahoma. An energy balance account is presented in the second section and gives data on energy use and production in Oklahoma for the base year 1977 and relates these data to the economic sectors of an Oklahoma input-output model. Direct energy coefficients are estimated for the interregional input-output model in this section.

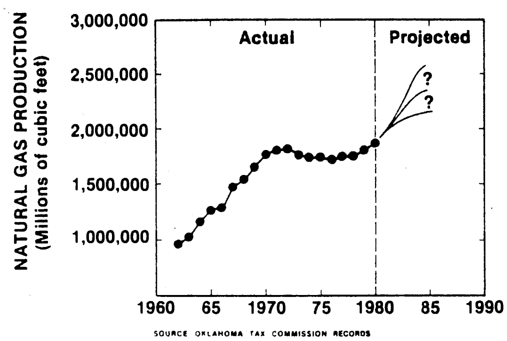
Trends in Energy Production, Consumption, Trade and Prices in Oklahoma

Production and Consumption

General trends in energy production and consumption for Oklahoma have been assessed by the Institute for Energy Analysis, Oklahoma State University (79) and are presented in Figures 2 and 3. Oklahoma is a major fossil fuel producer, ranking fifth among states in the production of crude petroleum and third in the production of natural gas. But the production of crude oil has declined annually since 1967. Production of natural gas has slightly increased since 1976. Coal production

Energy Production In Oklahoma

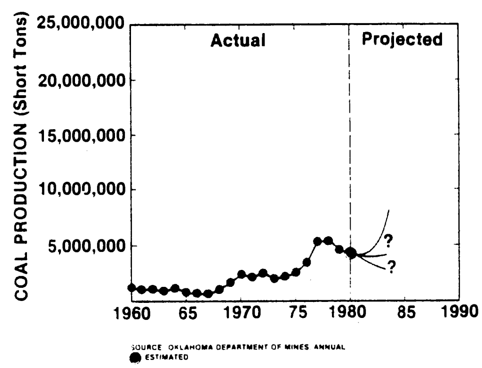




CRUDE OIL: Production has been declining for several years. The decontrol of petroleum prices in February 1981 will result in sharply increased drilling activity, which will increase production in the short run.

NATURAL GAS: Partial decontrol of gas prices in the late 1970's caused an increase in drilling and production. There is optimism that very large reserves of "deep" gas will permit greatly increased production for several more years.

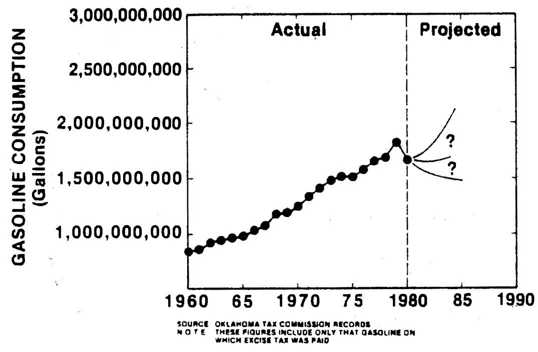
COAL: Oklahoma's large coal reserves remain essentially unexploited due to the high sulfur content of the coal and to its occurrence in thin seams. Eventually, coal will likely play a larger role in Oklahoma's energy picture.

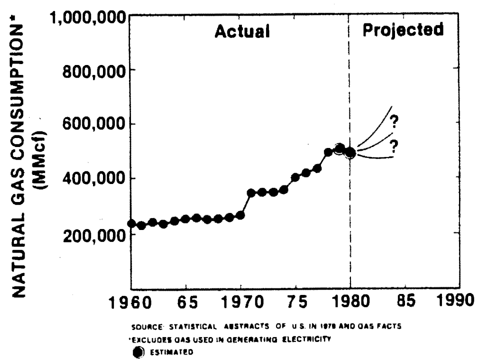


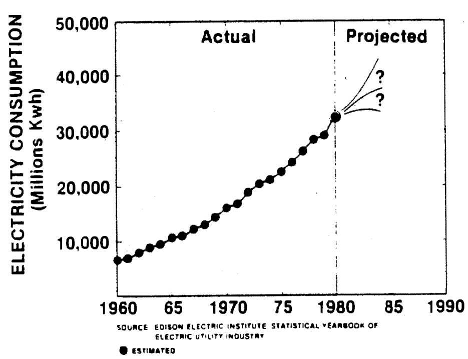
Source: Institute for Energy Analysis, Oklahoma State University (79).

Figure 2. Trends in Energy Production in Oklahoma

Energy Consumption In Oklahoma







GASOLINE: Gasoline usage by Oklahomans dropped dramatically in 1980, following sharp price increases. Further price increases expected in 1981 and 1982 will likely curtail usage. The long-term effect of price increases is unknown.

NATURAL GAS: The high consumption in 1978 and 1979 was caused by very cold winters. Consumption dropped in 1980 due to a mild winter. Conservation efforts and smaller houses will likely moderate the rate of consumption increase.

ELECTRICITY: The rate of increase in electricity consumption has followed a remarkably smooth pattern for many years. The record hot summer of 1980 caused consumption to be unusually high. Predicting future consumption trends is particularly difficult for electricity because of so many variables involved, such as the rate and type of industrial expansion.

Source: Institute for Energy Analysis, Oklahoma State University (79).

Figure 3. Trends in Energy Consumption in Oklahoma

remains uncertain due to high sulfur content of Oklahoma coal and whether legislation requiring conversion from natural gas to coal in generating electricity will hold.

Energy consumption in Oklahoma is not atypical from consumption in other parts of the country. Higher energy prices lead to energy conservation. Electricity consumption, however, continues to show strong increases. Growth in industrial development is the key to continued expansion in state energy consumption.

Data sources of Oklahoma energy production and consumption are discussed extensively in Hirunruk et al. <u>Energy Data Base for Oklahoma by Economic Sector and Energy Source</u> (45).

<u>Trade</u>

Estimated trends of net exports of energy from Oklahoma are shown for years 1965 through 1978 in Table XIX. Oklahoma's net exports of all energy sources currently equals approximately half of its production. However, the trend in net exports is declining as consumption continues to increase while production is decreasing. In 1977, Oklahoma produced 2,970.530 trillion BTUs and consumed 1,404.845 trillion BTUs which left 1,565.685 trillion BTUs for export. On the other hand, in 1972 Oklahoma produced 3,229.176 trillion BTUs and consumed only 1,168.426 trillion BTUs, hence left 2,060.750 trillion BTUs for export.

TABLE XIX

OKLAHOMA ENERGY PRODUCTION, CONSUMPTION AND TRADE, 1965-1978
(TRILLION BTUs)

Activity and Fuel	1965	1966	1967	1968	1969	1970	1971
Production							
Crude Petroleum[1]	1,179.958	1,304.066	1,338.344	1,297.013	1,303.428	1,296.729	1,237.215
Natural Gas[2]	1,294.868	1,309.469	1,518.990	1,581.317	1,694.813	1,833.904	1,846.704
Coal[3]	21.343	18.642	18.266	24.465	40.671	54.066	49.439
Electricity and Hydropower[4]	44.110	48.959	52.623	57.806	68.984	79.790	84.191
Total Production	2,540.279	2,681.136	2,928.223	2,886.892	3,107.896	3,264.489	3,217.549
Consumption[5]							
Refined Petroleum Products	314.167	328.885	338.676	364.656	376.641	400.788	403.423
Natural Gas	482.886	453.268	463.758	511.855	563.123	615.681	630.541
Coal	0.765	0.788	0.642	0.513	0.156	0.184	0.194
Electricity and Hydropower	44.768	44.911	48.933	61.700	71.458	71.375	75.087
Total Consumption	842.586	827.852	852.069	938.724	1,011.378	1,088.028	1,109.245
Export	1,697.693	1,853.284	2,076.154	1,948.168	2.096.,518	2,176.461	2,108.304

TABLE XIX (Continued)

Activity and Fuel	1972	1973	1974	1975	1976	1977	1978
Production							
Crude Petroleum	1,204.215	1,108.983	1,031.153	946.134	936.426	907.015	872.645
Natural Gas	1,876.762	1,823.328	1,799.443	1,793.269	1,770.331	1,806.679	1,807.219
Coal	56.014	48.487	52.583	63.099	80.302	132.353	120.198
Electricity and Hydropower	92.185	104,056	113.036	113.493	119.809	124.483	139.370
Total Production	3,229.176	3,084.854	2,996.215	2,915.995	2,906.868	2,970.530	2,939.432
Consumption							
Refined Petroleum Products	436.603	459.617	449.640	456.665	475.948	496.780	533.376
Natural Gas	646.760	625.055	675.263	684.001	775.876	784.897	788.830
Coal	0.186	4.616	4.775	0.543	1.727	13.427	45.472
Electricity and Hydropower	84.877	113.157	115.396	110.028	99.440	109.741	115.784
Total Consumption	1,168.426	1,251.227	1,245,074	1,251.237	1,352.991	1,404.845	1,483.462
Export	2,060.750	1.833.627	1,751.141	1,664.758	1,533.877	1,565.685	1,455.970

TABLE XIX (Continued)

Sources: [1]American Petroleum Institute, Basic Petroleum Data Book, Volume 1, Number 3.

[2]Oklahoma Tax Commission Records (Fiscal Year Basis) and Oklahoma State University, Institute for Energy Analysis Report.

[3]Oklahoma Department of Mines, Annual Reports and Bureau of Mines, Mineral Yearbooks.

[4]Edison Electric Institute, Statistical Yearbook of Electric Utility Industry.

[5]U.S. Department of Energy, State Energy Data Report: Statistical Tables and Technical Recommendation 1960 through 1978, April 1980.

Prices

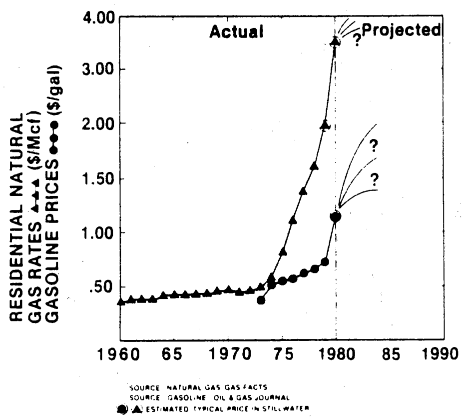
Data on energy prices in Oklahoma during the past decade are shown in Table XX. Trends in energy prices, as assessed by the Institute for Energy Analysis (79), are presented in Figure 4. Energy price changes are dependent on legislation and world energy prices. Since the oil embargo in 1973, crude oil prices rose dramatically from $3.78 per barrel in 1973 to $7.18 per barrel in 1974 and $25.09 per barrel in 1980. Gasoline prices respond to changes in oil prices. Regular leaded gasoline increased from 37.53 cents per gallon in 1973 to 50.33 cents per gallon in 1974 and $1.15 per gallon in 1980.

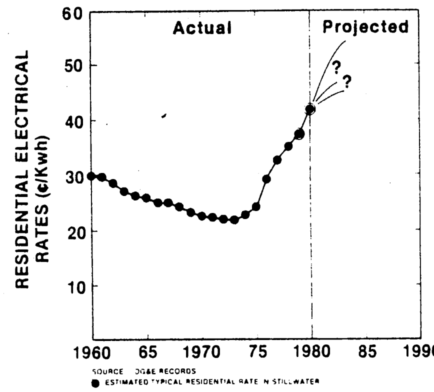
The partial price decontrol of natural gas has had a strong impact on natural gas prices since 1975. Average wellhead value of natural gas rose from 32 cents per thousand cubic feet in 1975 to $1.51 per thousand cubic feet in 1980.

Residential electric prices actually declined steadily for several years. The recent price increases were due primarily to increases in natural gas prices. Electricity rates rose from 2.30 cents per kilowatt-hour in 1975 to 4.20 cents per kilowatt-hour in 1980. Rates are predicted to rise dramatically if all generating plants are required to convert from natural gas to coal by 1990, as is now the law (79).

Recent data for crude oil and natural gas prices in Oklahoma were estimated from national energy price data assuming that crude oil and natural gas prices in Oklahoma change at the same percentage as that of the nation during the period 1980-82. Crude oil prices declined from $38.14 per barrel in 1981 to $30.09 per barrel in 1982, or 21.1 percent decrease. Gasoline prices fell from $1.31 per gallon in 1981 to $1.23

Energy Prices In Oklahoma



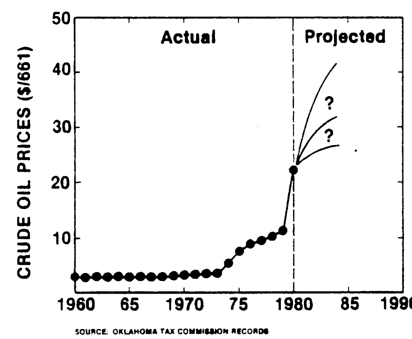


GASOLINE: Gasoline prices respond to increases in oil prices. Particularly significant are the sharp increases in 1974 and 1980.

NATURAL GAS: The effect of partial price decontrol is evident for the years since 1975. Complete decontrol could cause further increases, but could also result in temporary surpluses, which would suppress prices.

RESIDENTIAL ELECTRIC: Prices actually declined steadily for several years. The price increases were due primarily to increases in natural gas prices. Rates are predicted to rise dramatically if all generating plants are required to convert to other fuels by 1990, as is now the law.

CRUDE OIL: The doubling of oil prices in one year (1980) is the most dramatic shock our economy has ever encountered. Further increases will follow the decontrol order of President Reagan in February 1981.



Source: Institute for Energy Analysis, Oklahoma State University (79).

Figure 4. Trends in Energy Prices in Oklahoma

TABLE XX

OKLAHOMA ENERGY PRICES, 1970-1982

Year	Crude Oil ($/bbl)	Regular Leaded Gasoline (¢/gallon)	Natural Gas at Wellhead (¢/MCF)	Natural Gas Residential (¢/MCF)	Electricity (¢/Kwh.)	Coal[4] ($/ton)
1970	3.19	35.07	15.6	47.5	2.28	6.27
1971	3.40	35.07	16.3	42.7	2.26	6.72
1972	3.39	34.73	16.3	44.8	2.20	7.28
1973	3.78	37.53	18.9	50.0	2.20	7.69
1974	7.18	50.33	28.0	59.8	2.30	10.51
1975	8.52	56.44	32.0	81.0	2.42	12.96
1976	9.19	59.46	50.2	111.9	2.95	17.03
1977	9.98	63.74	79.0	149.4	3.27	17.77
1978	10.90	66.70	90.2	160.3	3.53	18.50
1979	15.03	72.90	112.4	198.0	3.74	18.69
1980	25.09	115.00	150.7	276.0	4.20	26.27
1981[5]	38.14	131.10	185.4	N.A.	N.A.	N.A.
1982[5]	30.09	122.90	215.0	N.A.	N.A.	N.A.

TABLE XX (Continued)

Sources: [1]American Petroleum Institute, Basic Petroleum Data Book, Petroleum Industry Statistics, Volume II, Number 3, September 1982.

[2]Institute for Energy Analysis, Okalhoma State University.

[3]Regular leaded gasoline at full service station.

[4]1970-74 United States Department of the Interior, Bureau of Mines, Mineral Yearbook, Volume I, Metals, Minerals and Fuels.

[5]Estimated from national data.

per gallon in 1982, a 6.3 percent decline. Natural gas prices rose from $1.85 per thousand cubic feet at wellhead in 1981 to $2.15 per thousand cubic feet in 1982, a 16.0 percent increase.

Oklahoma Energy Balance Account

The energy balance account contains information on energy consumption by economic sector and type of energy and on production of energy by type. All of the energy statistics are for the benchmark year of 1977 and developed from secondary data. The base year 1977 is chosen because it is the year that the Department of Commerce has conducted its latest Censuses and forms the base year of the input-output accounts. Hence most energy statistics and other related data are referred to this base year.

By Major Economic Sector

The principal data source on energy use by type is the Department of Energy, State Energy Data Report: Statistical Tables and Technical Documentation 1960 through 1978 (124). Data from the Bureau of Census, U.S. Department of Energy, and the U.S. Department of Agriculture are used for allocating total energy use by energy type to the input-output sectors for Oklahoma. Data on production of petroleum products, natural gas and bituminous coal are obtained from the Department of Energy, Energy Data Reports (125, 126, 127) and the quantity of electricity produced is obtained from The Edison Electric Institute (22). Physical quantities of energy are converted to British Thermal Units (BTUs) using the Department of Energy (128) as the source of the conversion factors.

Energy balance statements for Oklahoma in 1977 are shown in both physical units and BTU units, respectively, in Tables XXI and XXII. These data differ from Table XIX in that they show the allocation of energy consumption by end-use sector while data in Table XIX show only the aggregate consumption of energy by type. In 1977, Oklahoma produced 2,970.530 trillion BTUs of energy and consumed 1,404.845 trillion BTUs. Petroleum and petroleum products and natural gas accounted for 91.3 percent of total energy production and 91.5 percent of total energy consumption. Natural gas alone accounted for 61.8 percent of total energy produced and 54.3 percent of total energy consumed.

About 60 percent of petroleum and petroleum products and 40 percent of natural gas were produced and consumed within the state. Coal production constituted only 4.4 percent of total energy produced and 0.9 percent of total consumption. Only 10 percent of coal produced was consumed locally with the rest exported. Electricity and hydropower's share of total energy produced was 4.2 percent versus 7.6 percent of total energy consumption. About 88.1 percent of electricity and hydropower generated was used within the state. These data on energy consumption indicate a strong dependence on the conventional energy sources of natural gas and petroleum products.

The industrial sector consumed about 30.3 percent of total energy used, electricity generation about 26.3 percent and transportation about 22.2 percent. Residential and commercial sectors consumed about 21.1 percent.

Transportation and industrial sectors dominated the consumption of petroleum and petroleum products at 57.1 percent and 23.2 percent, respectively. The residential sector used 9.1 percent and the

TABLE XXI

OKLAHOMA ENERGY BALANCE, 1977
(PHYSICAL UNITS)

	Petroleum (thousand barrels)	Natural Gas (million cu. ft.)	Coal (thousand s.t.)	Elec. & Hydropower (million KWH)
Production	156,382[1]	1,769,519[2]	5,978[3]	36,484[4]
Consumption by End-Use Sector[5]				
Residential	11,587	86,822	2	10,304
Commercial	8,602	48,253	5	7,693
Industrial	16,840	270,721	226	8,743
Transportation	53,129	27,424	0	74
Electric Utilities	187	333,766	438	1,749
Total Consumption	90,345	766,986	671	28,563
Balance	66,037	1,022,533	5,307	7,921

TABLE XXI (Continued)

Sources: [1] U.S. Department of Energy, Energy Data Report, Crude Petroleum and Natural Gas Liquid, 1977 Final Summary, DOE/EIA-0108(77).

[2] U.S. Department of Energy, Energy Data Report, Natural Gas Production and Consumption, 1977 DOE/EIA-0131.

[3] U.S. Department of Energy, Energy Data Report, Bituminous Coal and Lignite Production and Mine Operation, 1977, DOE/EIA-0118(77).

[4] Edison Electric Institute, Statistical Yearbook of the Electric Utility Industry.

[5] U.S. Department of Energy, State Energy Data Report: Statistical Tables and Technical Documentation, 1960 through 1978, DOE/EIA-0214(78).

TABLE XXII

OKLAHOMA ENERGY BALANCE, 1977
(TRILLION BTUs)

	Petroleum	Natural Gas	Coal	Electricity & Hydropower	Total
Production[1]	907.015	1,806.679	132.353	124.483	2,970,530
Consumption by End-Use Sector[2]					
Residential	45.023	88.472	.063	34.158	168.716
Commercial	51.555	49.170	.117	26.248	127.090
Industrial	115.374	275.865	5.888	29.830	426.957
Transportation	283.736	27.945	--	0.251	311.932
Electric Utilities	1.092	343.445	7.359	18.254	370.150
Total Consumption	496.780	784.897	13.427	109.741	1,404.845
Balance	410.235	1,021.782	118.926	14.742	1,565.685

Sources: [1]Derived from Table XXI by using the following conversion factors to British Thermal Units.

Electricity energy = 3.412 thousand BTU/Kwh
Coal = 22.140 million BTU/short ton
Petroleum = 5.800 million BTU/barrel
Natural Gas = 1.021 thousand BTU/cu. ft.

[2]U.S. Department of Energy. Energy Data Report, Statistical Tables and Technical Documentation 1960 through 1978, DOE/EIA-0214(78).

commercial sector consumed 10.4 percent of total petroleum products. Electric utilities used only 0.2 percent of total petroleum products consumed but dominated the consumption of natural gas at 43.7 percent. The industrial sector consumed 35.1 percent of total natural gas. Residential, commercial, and transportation sectors used 11.2 percent, 6.2 percent, and 3.5 percent, respectively, of the total natural gas.

About 54.8 percent of coal consumption in BTUs was used for generating electric utilities and 43.8 percent was used for industrial purposes. Residential and commercial sectors used only 1.3 percent of total coal consumed while the transportation sector did not use coal at all.

Proportions of electricity consumption by end-use sector included: residential at 32.0 percent, industrial at 27.1 percent, commercial at 23.9 percent, generating electricity and hydropower at 16.6 percent, and transportation at 0.2 percent.

Petroleum sector energy balance in 1977 is shown in Table XXIII. Consumption of petroleum by end-use sector is presented in Table XXIV. Petroleum products were consumed mainly as motor gasoline, distillate fuel, LPG, asphalt and jet fuel. Motor gasoline constituted about 44.3 percent of total petroleum products consumption. Distillate fuel, LPG, asphalt and jet fuel constituted 14.9 percent, 12.9 percent, 6.1 percent, and 4.8 percent of total petroleum products consumed, respectively. The transportation sector including household transporation was the major consumer of petroleum products, using 98.5 percent of total motor gasoline consumed and 47.4 percent of total distillate fuel consumed.

TABLE XXIII

PETROLEUM SECTOR ENERGY BALANCE, OKLAHOMA, 1977
(TRILLION BTUs)

		Trillion BTUs
Production of Petroleum		907.015
Consumption of Petroleum		
Aviation Gasoline	1.532	
Asphalt	30.505	
Distillate Fuel	74.385	
Jet Fuel	23.874	
Kerosene	1.368	
LPG	64.435	
Lubricants	8.221	
Motor Gasoline	220.116	
Residual Oil	4.155	
Road Oil	0.327	
Other Petroleum Products	67.863	
Total Consumption of Petroleum		496.781
Balance		410.234

Source: Same as Table XXII.

TABLE XXIV

CONSUMPTION OF PETROLEUM BY END-USE SECTORS, OKLAHOMA, 1977

Sector	Aviation Gasoline	Asphalt	Distill-ate Fuel	Jet Fuel	Kero-sene	LPG	Lubri-cants	Motor Gasoline	Residual Oil	Road Oil	Other Petroleum Products	Total Petroleum
Residential	--	--	0.280	--	0.856	43.888	--	--	--	--	--	45.024
Commercial	--	30.505	13.701	--	--	4.876	--	1.480	0.666	0.327	--	51.555
Industrial	--	--	24.036	--	0.512	14.199	3.510	1.809	3.445	--	67.863	115.374
Transportation	1.532	--	35.320	23.874	--	1.472	4.711	216.827	--	--	--	283.736
Electric Utilities	--	--	1.048	--	--	--	--	--	0.444	--	--	1.092
Total	1.532	30.505	74.385	23.874	1.368	64.435	8.221	220.116	4.155	0.327	67.863	496.781

Source: Same as Table XXIII.

By Input-Output Sector

Energy data and data sources from the previous sections are not sufficient for allocating energy consumption at the state level among sectors of an input-output model. Therefore, certain procedures are used to further disaggregate the energy consumption data as needed for an input-output model.

Various data sources and allocation rules were used to distribute energy consumption to the more detailed input-output sectors. Some of the allocation procedures are arbitrary. However, in the aggregate, total sector energy consumption is reasonable even though the source of energy may at times be inconsistent with known methods of energy use.

The allocation rules have relied only on secondary data sources and not primary data or field observations. Energy and U.S. Agriculture, 1978 (106) and 1978 Census of Agriculture (113) were used to allocate energy consumption among the agriculturl sectors.

The 1977 Census of Manufacturers: Fuels and Electric Energy Used for Heat and Power (116) presents data for ten manufacturing sectors in Oklahoma on consumption of purchased fuels and electric energy. To complete the allocation of energy use to all manufacturing industries in the input-output model, ratios from the U.S. census data on energy consumption were used.

Energy consumption by the mineral industries in Oklahoma were collected from the 1977 Census of Mineral Industries: Fuels and Electric Energy Consumed (117). Energy consumption data for the construction sectors were collected from the 1977 Census of Construction Industries (114).

Energy consumption in Oklahoma by other sectors of the input-output model were estimated from gross energy consumption as described earlier and allocated using ratios of sector output to total output of the major economic sectors.

The estimated Oklahoma energy balance statement by input-output sector and by energy type in billion BTUs for the base year 1977 is presented in Table XXV. This energy balance statement shows the same net exports of each energy type as shown in Table XXI. However, this energy balance statement has the advantage over the more aggregated energy balance in that it shows how each energy type was consumed by input-output sector of the economy.

In 1977, total processing sectors in Oklahoma consumed 945,488 billion BTUs of energy or 67.3 percent of total energy consumed in Oklahoma. The final demand sectors consumed 459,357 billion BTUs or 32.7 percent of total energy consumed. The transportation and warehousing sector (I-O Sector 63) consumed 153,986 billion BTUs or 11.0 percent of total energy consumed within the state. Manufacturing industries consumed 115,180 billion BTUs or 8.2 percent of total energy used. Energy processing sectors consumed 544,421 billion BTUs or 38.75 percent of total energy used. Electricity generation consumed 26.3 percent of total energy used. Petroleum products and natural gas producing industries consumed 10.3 percent of all energy used. Agricultural, mining and construction industries consumed 71,052 billion BTUs or 5.1 percent of total energy used.

Transportation and warehousing dominated the consumption of petroleum products used at 25.3 percent of total petroleum products used. The household industry and manufacturing industries consumed 49.0

TABLE XXV

ESTIMATED OKLAHOMA ENERGY BALANCE STATEMENT BY INPUT-OUTPUT SECTOR AND ENERGY TYPE, 1977
(Billion BTUs)

Input-Output Sector	Petroleum Products	Natural Gas	Electricity	Coal	Total Energy
1. Livestock and livestock products	3,838.126	275.670	399.204	0.0	4,513.000
2. Crop and other agricultural products	29,904.083	6,094.349	559.568	0.0	36,558.000
3. Forestry and fishery products	704.718	664.473	60.282	0.0	1,430.473
4. Agricultural, forestry and fishery services	3,115.038	2,941.562	266.459	0.0	6,323.059
Agriculture, Forestry and Fisheries	37,561.965	9,977.054	1,285.513	0.0	48,824.532
5. Iron and ferroalloy ores mining	0.0	0.0	0.0	0.0	0.0
6. Nonferrous metal ores mining	158.434	179.066	60.686	0.0	398.186
7. Stone and clay mining and quarrying	1,445.093	243.038	266.280	0.0	1,954.411
8. Chemical and fertilizer mineral mining	303.424	0.0	42.165	0.0	345.589
Mining Except Fuels	1,906.951	422.104	369.131	0.0	2,698.186
9. New construction	12,795.630	1,708.228	776.330	0.0	15,280.188
10. Maintenance and repair construction	3,558.014	474.998	215.870	0.0	4,248.882
Construction	16,353.644	2,183.226	992.200	0.0	19,529.070
AGRICULTURAL, MINING AND CONSTRUCTION	55,822.560	12,582.384	2,646.844	0.0	71,051.788
11. Ordnance and accessories	99.156	350.902	78.005	0.0	528.063
12. Food and kindred products	836.864	3,379.200	1,283.936	0.0	5,500.000
13. Tobacco manufacturers	0.0	0.0	0.0	0.0	0.0
14. Broad and narrow fabrics, yarn, etc.	97.628	102.400	99.972	0.0	300.000
15. Misc. textile goods and floor covering	55.244	659.244	85.300	0.0	800.000
16. Apparel	115.068	76.800	208.132	0.0	400.000
17. Misc. fabricated textile products	40.014	34.816	25.170	0.0	100.000
18. Lumber and weood product, except container	749.875	1,521.588	428.537	0.0	2,700.000
19. Wood containers	50.501	37.888	11.611	0.0	100.000

TABLE XXV (Continued)

Input-Output Sector	Petroleum Products	Natural Gas	Electricity	Coal	Total Energy
20. Household furniture	29.358	33.792	36.850	0.0	700.000
21. Other furniture and fixture	27.041	102.400	11.942	0.0	141.383
22. Paper and allied product except container	6,210.332	9,618.431	1,041.217	0.0	16,869.980
23. Paperboard container and boxes	158.810	570.571	86.666	0.0	816.047
24. Printing and publishing	119.828	399.052	381.120	0.0	900.000
25. Chemicals and selected chemical products	8,824.390	20,085.760	2,089.850	0.0	31,000.000
26. Plastics and synthetic materials	19.380	19.355	6.240	0.0	44.975
27. Drugs, cleaning and toilet products	76.357	27.742	9.360	0.0	113.459
28. Paints and allied products	29.873	51.702	18.425	0.0	100.000
29. Paving and floor materials	685.134	2,109.693	87.539	0.0	2,882.366
30. Rubber and misc. plastic products	1,124.366	2,764.800	1,510.834	0.0	5,400.000
31. Leather tanning and finishing	71.773	104.130	9.386	0.0	185.289
32. Footwear and other leather products	21.767	54.204	26.468	0.0	102.439
33. Glass and glass products	902.912	5,615.740	781.348	0.0	7,300.000
34. Stone and clay products	1,170.399	8,601.600	1,077.510	5,845.194	16,694.703
35. Primary iron and steel manufacturing	637.137	1,595.392	899.342	186.789	3,318.660
36. Primary nonferrous metal manuf.	85.878	758.784	1,069.041	36.017	1,949.720
37. Metal containers	14.972	636.488	22.327	0.0	673.787
38. Heating, plumbing, structure & metal products	252.407	335.073	212.520	0.0	800.000
39. Screw machine products	394.635	632.586	272.779	0.0	1,300.000
40. Other fabricated products	412.408	568.341	319.251	0.0	1,300.000
41. Engines and turbines	64.678	305.256	59.523	0.0	429.457
42. Farm and garden machinery	60.914	110.425	28.661	0.0	200.000
43. Construction and mining machinery	178.554	819.200	502.246	0.0	1,500.000
44. Materials handling machinery and equipment	16.905	701.277	236.981	0.0	355.163

TABLE XXV (Continued)

Input-Output Sector	Petroleum Products	Natural Gas	Electricity	Coal	Total Energy
45. Metal working machinery and equipment	49.749	366.593	94.566	0.0	510.908
46. Special industry machinery and equipment	56.272	238.292	50.958	0.0	345.522
47. General industry machinery and equipment	23.565	307.200	169.235	0.0	500.000
48. Misc. machinery except electrical	52.975	172.643	74.382	0.0	300.000
49. Office, computing, and accounting machinery	16.874	156.908	70.918	0.0	244.700
50. Service industry machines	43.795	363.760	71.906	0.0	479.441
51. Electric industrial equipment and apparatus	3.183	56.214	40.603	0.0	100.000
52. Household appliances	41.421	517.795	68.672	0.0	627.888
53. Electric lighting and wiring equipment	48.461	299.549	56.325	0.0	404.335
54. Radio, TV and communication equipment	86.340	436.488	140.663	0.0	663.491
55. Electronic components and accessories	67.374	316.668	151.995	0.0	536.037
56. Misc. electrical machinery and supplies	136.052	265.316	66.366	0.0	467.734
57. Motor vehicle and equipments	322.460	2,945.582	488.052	0.0	3,756.094
58. Aircraft and parts	62.779	245.346	165.729	0.0	473.854
59. Other transportation equipment	126.563	325.227	83.344	0.0	535.134
60. Scientific and controlling instruments	32.396	171.172	57.313	0.0	260.881
61. Optical, ophalmic and photographic equipment	38.575	322.374	76.632	0.0	437.587
62. Miscellaneous manufacturing	55.421	85.893	58.686	0.0	200.000
MANUFACTURING	24,898.813	69,273.167	14,940.235	6,068.000	115,180.215
63. Transportation and warehousing	125,790.000	27,945.000	251.000	0.0	153,986.000
64. Communication, except radio and TV	9.206	55.219	340.636	0.0	405.061
65. Radio and TV broadcasting	1.578	37.522	204.412	0.0	243.512
66. Water supply and sanitary services	1.025	137.058	163.821	0.0	301.904
Transportation, Communication and Utilities	125,801.809	28,174.799	959.869	0.0	154,936.477
67. Wholesale and retail trade	786.147	4,840.843	5,517.449	0.0	11,144.439

TABLE XXV (Continued)

Input-Output Sector	Petroleum Products	Natural Gas	Electricity	Coal	Total Energy
68. Finance and Insurance	25.431	352.221	170.298	0.0	547.950
69. Real estate and rental	65.392	907.347	437.907	0.0	1,410.646
Finance, Insurance and Real Estate	90.823	1,259.568	608.205	0.0	1,958.596
70. Hotels and lodging, personal and repair services (except auto)	78.795	1,255.077	527.659	0.0	1,861.531
71. Business services	188.955	2,659.279	1,265.376	0.0	4,113.610
72. Eating and drinking places	245.281	1,276.967	1,561.140	0.0	3,083.388
73. Automobile repair and services	69.494	962.518	465.375	0.0	1,497.387
74. Amusements	26.044	373.830	320.448	0.0	720.322
75. Health, educational and social services and non-profit organization	101.140	12,865.304	2,361.358	0.0	15,327.802
Services	709.709	19,392.975	6,501.356	0.0	26,604.040
76. Federal government enterprises	132.974	9,161.855	1,462.204	0.0	10,757.033
77. State and local government enterprises	88.195	7,284.733	7,263.666	0.0	8,636.594
Government Enterprise	221.169	16,446.588	2,725.870	0.0	19,393.627
TRANSPORTATION, COMMUNICATION, TRADE & SERVICES	127,609.657	70,114.773	16,312.749	0.0	214,037.179
78. Petroleum Production	11,980.137	80,107.343	4,939.829	0.0	97,027.309
79. Natural Gas Production	12,983.235	59,313.274	3,547.527	0.0	75,844.036
80. Coal Mining	842.470	0.0	557.530	0.0	1,400.000
81. Electricity and Hydropower	1,092.000	343,445.000	18,254.000	7,359.000	370,150.000
Energy Processing	26,897.842	482,865.617	27,298.886	7,359.000	544,421.345
TOTAL PROCESSING SECTORS	235,228.872	634,835.941	61,995.995	13,427.000	945,487.808
82. Household industry	243,635.042	126,548.111	34,687.122	0.0	404,870.275
83. Federal government - defense	2,621.293	1,444.214	1,107.665	0.0	5,173.172

TABLE XXV (Continued)

Input-Output Sector	Petroleum Products	Natural Gas	Electricity	Coal	Total Energy
84. Federal government - nondefense	6,143.986	3,385.061	2,596.234	0.0	12,125.282
85. State and local government - education	3,459.609	7,062.981	3,535.945	0.0	14,058.535
86. State and local government - other	5,691.198	11,620.692	5,818.039	0.0	23,129.929
Total Final Demand Sector	261,551.128	150,061.059	47,745.005	0.0	459,357.192
TOTAL ENERGY CONSUMPTION	496,780.000	784,897.000	109,741.000	13,427.000	1,404,845.000
ENERGY PRODUCTION	907,015.000	1,806,678.000	124,483.000	132,353.000	2,970,530.000
EXPORT OF ENERGY	410,235.000	1,021,781.000	14,742.000	118,926.000	1,565,685.000

percent and 5.0 percent, respectively, of total petroleum products used. Processing sectors used 47.4 percent and the final demand sectors consumed 52.6 percent of total consumption of petroleum products. Electricity generation was the leading natural gas consumer at 43.7 percent. Petroleum products and natural gas producing industries consumed 17.8 percent of total natural gas consumed. Manufacturing industries consumed 8.8 percent of total natural gas used. The processing sectors used 80.9 percent of total natural gas consumed while the remaining 19.7 percent was used by the final demand sectors.

Manufacturing industries consumed 13.6 percent of total electricity while 16.6 percent was used within the electricity generating sector itself. Processing sectors consumed 56.5 percent of all electricity consumed while the remaining 43.5 percent was used by the final demand sectors. The household industry consumed 31.6 percent of total electricity consumed.

Energy Accounts in the Interregional Input-Output Model

Energy Direct Coefficients

Oklahoma energy balance statement by input-output sector and energy type as presented in Table XXV are expressed in physical units. These data need to be transformed into monetary units before they are integrated into an interregional input-output model for the purpose of evaluating the impacts of energy price changes.

Data of producers energy prices per million BTU for both Oklahoma and Rest of U.S. in 1977 are presented in Table XXVI. Prices of petroleum products were determined as the weighted average between the wellhead value of crude oil and the petroleum refinery product value. Prices of petroleum products production for both Oklahoma and Rest of U.S. were obtained by dividing the sum of the dollar value of crude oil production and the petroleum refinery products after subtracting the intrasectoral transaction between crude oil and petroleum refining sectors by the physical quantity of crude oil production. These prices reflect the petroleum product prices paid by all other processing sectors.

Petroleum product prices were $3.20 and $2.75 per million BTU in Oklahoma and Rest of U.S., respectively. Natural gas prices were about 77.38 cents per million BTU in both regions. Coal prices were 80.13 cents and 94.70 cents per million BTU for Oklahoma and Rest of U.S., respectively. Electricity prices were $8.09 per million BTU in Oklahoma and $10.02 per million BTU in Rest of U.S.

Estimated dollar value of energy output for Oklahoma and Rest of U.S. in 1977 is presented in Table XXVII. The dollar value of petroleum products was estimated as the sum of the dollar value of crude oil production at wellhead prices plus the dollar value of petroleum refinery products minus the dollar value of the intrasectoral consumption of crude oil production in Oklahoma in 1977. The dollar value of crude oil production was estimated as $1,578,478 thousand while the dollar value of petroleum refinery products and the intrasectoral consumption of petroleum products were estimated as $3,202,287 and

TABLE XXVI

ENERGY PRICES, 1977
($/MILLION BTU--PRODUCER'S PRICE)

Energy Source	Oklahoma	Rest of U.S.
Petroleum Products	3.1999	2.7479
Natural Gas	0.7738	0.7738
Coal	0.8013	0.9470
Electricity and Hydropower	8.0891	10.0234

Source: Black and Veatch Consulting Engineers, Energy Price Projection, Prepared for Economic Development Administration, U.S. Department of Commerce, April 1980.

TABLE XXVII

DOLLAR VALUE OF ENERGY OUTPUT, 1977
($1,000)

Energy Source	Oklahoma[1]	Rest of U.S.[2]
Petroleum Products	2,902,346	45,469,460
Natural Gas	1,398,008	13,741,389
Coal	106,054	14,864,725
Electricity and Hydropower	1,006,955	22,136,849

Source: [1]Computed from Tables XXII and XXVI.

[2]Compute from U.S. Department of Energy, Monthly Energy Review (128) and Table XXVI.

$1,878,419 thousand, respectively. This gives the estimate of the dollar value of petroleum product production at $2,902,346 thousand. The dollar value of output of other energy processing sectors in Oklahoma in 1977 are estimated as follows: $1,398,008 thousand for natural gas; $106,054 thousand for coal, and $1,006,955 thousand for electricity and hydropower. The dollar value of energy output in Rest of U.S. was estimated as follows: $45,469,460 thousand for petroleum products, $13,741,389 thousand for natural gas, $14,864,725 thousand for coal and $22,136,849 thousand for electricity and hydropower.

Oklahoma energy direct coefficients were derived by dividing the costs of energy consumption by input-output sector and by energy type by the corresponding sector total output. These energy coefficients were integrated into the Oklahoma direct coefficient matrix as rows 78 through 81. Direct coefficients of energy processing sectors for Rest of U.S. were derived directly from U.S. direct coefficients. The direct energy coefficient matrix for Oklahoma in 1977 is presented in Table XXVIII. Each coefficient indicates the energy cost of producing one dollar of output of that sector.

In Oklahoma, transportation and warehousing (sector 63) had the highest direct coefficient on petroleum products. Transportation and warehousing spent 24.06 cents for every one dollar of output. Paper and allied products, except containers ranked second in petroleum product cost per unit of output. Paper and allied products except containers (sector 22) spent 9.82 cents per one dollar of output. This was followed by crops and other agricultural products (sector 2); forestry and fishery products (sector 2); and agricultural forestry and fishery

TABLE XXVIII

VALUE OF OKLAHOMA ENERGY CONSUMPTION PER DOLLAR OF OUTPUT, 1977

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
1.	Livestock and livestock products	0.01019	0.00017	0.00000	0.00332
2.	Crops and other agricultural products	0.08965	0.00442	0.00000	0.00424
3.	Forestry and fishery products	0.08877	0.02027	0.00000	0.01919
4.	Agricultural, forestry and fishery services	0.08185	0.03057	0.00000	0.02895
5.	Iron and ferroalloy ores mining	--	--	--	--
6.	Nonferrous metal ores mining	0.07285	0.01323	0.00000	0.07054
7.	Stone and clay mining and quarrying	0.03207	0.00130	0.00000	0.01494
8.	Chemical and fertilizer mineral mining	0.00848	0.00000	0.00000	0.02964
9.	New construction	0.02106	0.00711	0.00000	0.00323
10.	Maintenance and repair construction	0.02692	0.00195	0.00000	0.00419
11.	Ordnance and accessories	0.02120	0.01815	0.00000	0.04592
12.	Food and kindred products	0.00162	0.00158	0.00000	0.00629
13.	Tobacco manufacturers	--	--	--	--
14.	Broad and narrow fabrics, yarn and thread mills	0.00811	0.00205	0.00000	0.02097
15.	Miscellaneous textile goods and floor coverings	0.00223	0.00643	0.00000	0.008870
16.	Apparel	0.00134	0.00022	0.00000	0.00614
17.	Miscellaneous fabricated textile products	0.00223	0.00046	0.00000	0.00355
18.	Lumber and wood products, except containers	0.00934	0.00458	0.00000	0.01349
19.	Wood containers	0.02344	0.00425	0.00000	0.01362
20.	Household furniture	0.00197	0.00055	0.00000	0.00625
21.	Other furniture and fixtures	0.00376	0.00344	0.00000	0.00420

TABLE XXVIII (Continued)

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
22.	Paper and allied products, except containers	0.09823	0.03679	0.00000	0.04163
23.	Paperboard containers and boxes	0.01092	0.00949	0.00000	0.01506
24.	Printing and publishing	0.00111	0.00089	0.00000	0.00894
25.	Chemicals and selected chemical products	0.07965	0.04384	0.00000	0.04769
26.	Plastics and synthetic materials	0.01930	0.00466	0.00000	0.01571
27.	Drugs, cleaning and toilet preparations	0.01850	0.00163	0.00000	0.00573
28.	Paints and allied products	0.00379	0.00158	0.00000	0.00590
29.	Paving and roofing materials	0.03580	0.02665	0.00000	0.01156
30.	Rubber and miscellaneous plastic products	0.00484	0.00288	0.00000	0.01645
31.	Leather tanning and finishing	0.03190	0.01119	0.00000	0.01055
32.	Footwear and other leather products	0.00558	0.00336	0.00000	0.01717
33.	Glass and glass products	0.01592	0.02394	0.00000	0.03482
34.	Stone and clay products	0.01307	0.02323	0.01635	0.03043
35.	Primary iron and steel manufacturing	0.01240	0.00751	0.00091	0.04423
36.	Primary nonferrous metal manufacturing	0.00204	0.00435	0.00021	0.06407
37.	Metal containers	0.00355	0.03651	0.00000	0.01339
38.	Heating, plumbing and structural metal products	0.00113	0.00036	0.00000	0.00240
39.	Screw machine products and stamping	0.03652	0.01416	0.00000	0.06381
40.	Other fabricated metal products	0.00513	0.00170	0.00000	0.01004
41.	Engines and turbines	0.00628	0.00717	0.00000	0.01461
42.	Farm and garden machinery	0.00359	0.00158	0.00000	0.00427
43.	Construction and mining machinery	0.00079	0.00087	0.00000	0.00559
44.	Materials handling machinery and equipment	0.00168	0.00243	0.00000	0.05945
45.	Metal working machinery and equipment	0.01013	0.01800	0.00000	0.04855

TABLE XXVIII (Continued)

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
46.	Special industry machinery and equipment	0.00161	0.00165	0.00000	0.00368
47.	General industrial machinery and equipment	0.00029	0.00093	0.00000	0.00534
48.	Miscellaneous machinery, except electrical	0.00151	0.00119	0.00000	0.00534
49.	Office, computing and accounting machines	0.00025	0.00056	0.00000	0.00265
50.	Service industry machines	0.00148	0.03100	0.00000	0.00297
51.	Electric industrial equipment and apparatus	0.00017	0.00072	0.00000	0.00545
52.	Household appliances	0.01335	0.00179	0.00000	0.00637
53.	Electric lighting and wiring equipment	0.00927	0.01385	0.00000	0.02723
54.	Radio, TV and communication equipment	0.00042	0.00051	0.00000	0.00173
55.	Electronic components and accessories	0.00441	0.00501	0.00000	0.02516
56.	Miscellaneous electrical machinery and supplies	0.02439	0.01150	0.00000	0.03008
57.	Motor vehicles and equipment	0.00386	0.00852	0.00000	0.01476
58.	Aircraft and parts	0.00080	0.00075	0.00000	0.00533
59.	Other transportation equipment	0.00648	0.00403	0.00000	0.01079
60.	Scientific and controlling instruments	0.00221	0.00283	0.00000	0.00990
61.	Optical, ophthalmic and photo equipment	0.00181	0.00366	0.00000	0.00910
62.	Miscellaneous manufacturing	0.00228	0.00086	0.00000	0.00611
63.	Transportation and warehousing	0.24056	0.01293	0.00000	0.00121
64.	Communications, except radio and TV	0.00007	0.00010	0.00000	0.00629
65.	Radio and TV broadcasting	0.00007	0.00038	0.00000	0.02195
66.	Water supply and sanitary service	0.00005	0.00146	0.00000	0.01820
67.	Wholesale and retail trade	0.00070	0.00105	0.00000	0.01249
68.	Finance and insurance	0.00007	0.00023	0.00000	0.00118
69.	Real estate and rental	0.00007	0.00024	0.00000	0.00123

TABLE XXVIII (Continued)

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
70.	Hotels; personal and repair service except auto	0.00048	0.00183	0.00000	0.00806
71.	Business services	0.00106	0.00360	0.00000	0.01792
72.	Eating and drinking places	0.00114	0.00144	0.00000	0.01838
73.	Automobile repair and services	0.00090	0.03166	0.00000	0.01531
74.	Amusements	0.00071	0.00245	0.00000	0.02209
75.	Health, education and social services and nonprofit organization	0.00016	0.00499	0.00000	0.00957
76.	Federal government enterprises	0.00165	0.02749	0.00000	0.04586
77.	State and local government enterprises	0.00147	0.02944	0.00000	0.05338
78.	Petroleum products production	0.01321	0.02136	0.00000	0.01377
79.	Natural gas production	0.02972	0.03283	0.00000	0.02052
80.	Coal mining	0.02542	0.00000	0.00000	0.04252
81.	Electricity and hydropower	0.00347	0.26392	0.00586	0.14664

services (sector 4) which spent 8.97 cents, 8.88 cents, and 8.82 cents, respectively as petroleum products for every one dollar of output. Livestock and livestock products (sector 1) spent 1.02 cents on petroleum products for every one dollar of output. Among the energy processing sectors, petroleum products, natural gas production, coal mining, electricity and hydropower spent 1.32 cents, 2.97 cents, 2.54 cents, and 0.35 cents on petroleum products for every one dollar of output, respectively.

Electricity and hydropower had the highest cost of natural gas per unit of output in Oklahoma in 1977. Electricity and hydropower (sector 81) spent 26.39 cents on natural gas for every dollar unit of output. Chemicals and selected chemical products (sector 25) ranked second among natural gas users. Chemicals and selected chemical products spent 4.38 cents on natural gas for every one dollar unit of output. Petroleum products production (sector 78) and natural gas production (sector 79) spent 2.14 cents and 3.28 cents on natural gas for every dollar unit of output, respectively.

Electricity and hydropower also had the highest direct coefficient on electricity and hydropower. Electricity and hydropower spent 14.66 cents on electricity and hydropower to generate one dollar of its output. Nonferrous metal ores mining (sector 6) and primary nonferrous metal manufacturing (sector 36) ranked second and third on electricity costs per unit of output. Nonferrous metal ores mining spent 7.05 cents on electricity and hydropower per one dollar of output, while primary nonferrous metal manufacturing spent 6.41 cents on electricity and hydropower. Screw machine products and stamping (sector 39) also had high electricity cost per unit of output. It spent 6.38 cents on electricity for every dollar of output. Other sectors with high electricity costs were materials handling machinery and equipment (sector 44) and state and local government enterprises (sector 77), with 5.95 cents and 5.34 cents, respectively. Petroleum products production spent 1.38 cents on electricity, while natural gas production and coal mining spent 2.05 cents and 4.25 cents on electricity and hydropower, respectively.

Direct energy coefficients for Rest of U.S. in 1977 are presented in Table XXIX. These direct energy coefficients were obtained directly from 1977 U.S. technical coefficients. Processing sectors with high petroleum product costs in Rest of U.S. were paving and roofing material (sector 29), stone and clay mining and quarrying (sector 7), and forestry and fishery products (sector 3), with 33.21 cents, 19.04 cents, and 18.74 cents, respectively. Petroleum product production (sector 78) and electricity and hydropower (sector 81) spent 13.00 cents and 13.46 cents on petroleum products, respectively.

Paving and roofing material (sector 29) had the highest ratio of natural gas consumption per unit of output in Rest of U.S., with 17.09 cents per dollar of output. The next highest natural gas consumers in Rest of U.S. were electricity and hydropower (sector 81), water supply and sanitary services (sector 66), and natural gas production (sector 79) which spent 16.47 cents, 15.09 cents, and 10.31 cents on natural gas for one dollar of output, respectively.

Coal production (sector 80) spent 22.94 cents on coal for producing one dollar of coal. Other processing sectors spent insignificant amount on coal for their production. Electricity and hydropower (sector 81),

TABLE XXIX

VALUE OF REST OF U.S. ENERGY CONSUMPTION PER DOLLAR OF OUTPUT, 1977

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
1.	Livestock and livestock products	0.01015	0.00427	0.00000	0.00598
2.	Crops and other agricultural products	0.04212	0.00217	0.00001	0.00305
3.	Forestry and fishery products	0.18750	0.00087	0.00000	0.0087
4.	Agricultural, forestry and fishery services	0.09300	0.00034	0.00000	0.01481
5.	Iron and ferroalloy ores mining	0.03192	0.03665	0.00828	0.05142
6.	Nonferrous metal ores mining	0.05874	0.03988	0.00072	0.05584
7.	Stone and clay mining and quarrying	0.19036	0.05053	0.00352	0.07050
8.	Chemical and fertilizer mineral mining	0.02492	0.02538	0.00138	0.03553
9.	New containers	0.03078	0.00047	0.00000	0.00006
10.	Maintenance and repair construction	0.07136	0.00096	0.00000	0.00135
11.	Ordnance and accessories	0.00783	0.00599	0.00155	0.00841
12.	Food and kindred products	0.00556	0.00407	0.00057	0.00570
13.	Tobacco manufacturers	0.00138	0.00052	0.00016	0.00190
14.	Broad and narrow fabrics, yarn and thread mills	0.00507	0.00636	0.00097	0.00889
15.	Miscellaneous textile goods and floor coverings	0.00597	0.00675	0.00012	0.00940
16.	Apparel	0.00608	0.00374	0.00011	0.00523
17.	Miscellaneous fabricated textile products	0.00326	0.00277	0.00048	0.00386
18.	Lumber and wood products, except containers	0.02830	0.00439	0.00332	0.00616
19.	Wood containers	0.02044	0.00490	0.00000	0.00654
20.	Household furniture	0.00770	0.00371	0.00057	0.00523
21.	Other furniture and fixtures	0.00805	0.00462	0.00134	0.00641

TABLE XXIX (Continued)

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
22.	Paper and allied products, except containers	0.02279	0.01276	0.00931	0.01788
23.	Paperboard containers and boxes	0.01410	0.00410	0.00029	0.00574
24.	Printing and publishing	0.00432	0.00296	0.00020	0.00414
25.	Chemicals and selected chemical products	0.01764	0.01826	0.00532	0.02283
26.	Plastics and synthetic materials	0.01562	0.00934	0.00388	0.01241
27.	Drugs, cleaning and toilet preparations	0.01488	0.00327	0.00049	0.00457
28.	Paints and allied products	0.02879	0.00268	0.00000	0.00328
29.	Paving and roofing materials	0.33206	0.17092	0.00041	0.00869
30.	Rubber and miscellaneous plastic products	0.00539	0.00020	0.00039	0.00027
31.	Leather tanning and finishing	0.01238	0.00367	0.00137	0.00501
32.	Footwear and other leather products	0.00435	0.00258	0.00016	0.00354
33.	Glass and glass products	0.00876	0.02109	0.00042	0.02953
34.	Stone and clay products	0.01970	0.01617	0.01102	0.02262
35.	Primary iron and steel manufacturing	0.01071	0.01671	0.03949	0.02339
36.	Primary nonferrous metal manufacturing	0.01005	0.01239	0.00074	0.01735
37.	Metal containers	0.00289	0.00418	0.00000	0.00589
38.	Heating, plumbing and structural metal products	0.00535	0.00334	0.00102	0.00466
39.	Screw machine products and stamping	0.00533	0.00424	0.00039	0.00591
40.	Other fabricated metal products	0.00618	0.00510	0.00019	0.00712
41.	Engines and turbines	0.00505	0.00365	0.00028	0.00514
42.	Farm and garden machinery	0.00682	0.00328	0.00050	0.00463
43.	Construction and mining machinery	0.00582	0.03343	0.00038	0.00469
44.	Materials handling machinery and equipment	0.00519	0.00443	0.00019	0.00616
45.	Metal working machinery and equipment	0.01586	0.00455	0.00022	0.00638

TABLE XXIX (Continued)

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
46.	Special industry machinery and equipment	0.01748	0.00421	0.00011	0.00593
47.	General industrial machinery and equipment	0.03937	0.01601	0.00018	0.00581
48.	Miscellaneous machinery, except electrical	0.02616	0.00569	0.00121	0.00799
49.	Office, computing and accounting machines	0.00310	0.00270	0.00017	0.00379
50.	Service industry machines	0.00880	0.00318	0.00049	0.00448
51.	Electric industrial equipment and apparatus	0.01206	0.00548	0.00057	0.00766
52.	Household appliances	0.00248	0.00358	0.00037	0.00505
53.	Electric lighting and wiring equipment	0.00317	0.00364	0.00035	0.00505
54.	Radio, TV and communication equipment	0.00267	0.00283	0.00003	0.00395
55.	Electronic components and accessories	0.00515	0.00445	0.00006	0.00623
56.	Miscellaneous electrical machinery and supplies	0.00010	0.00338	0.00022	0.02625
57.	Motor vehicles and equipment	0.00293	0.00195	0.00067	0.00273
58.	Aircraft and parts	0.00780	0.00350	0.00019	0.00491
59.	Other transportation equipment	0.01385	0.00470	0.00051	0.00658
60.	Scientific and controlling instruments	0.02242	0.00781	0.00017	0.01096
61.	Optical, ophthalmic and photo equipment	0.00654	0.00250	0.00169	0.00347
62.	Miscellaneous manufacturing	0.01383	0.00358	0.00015	0.00502
63.	Transportation and warehousing	0.09109	0.00488	0.00003	0.00626
64.	Communications, except radio and TV	0.00122	0.00494	0.00000	0.00691
65.	Radio and TV broadcasting	0.00405	0.00825	0.00000	0.01154
66.	Water supply and sanitary service	0.14712	0.15085	0.09179	0.14939
67.	Wholesale and retail trade	0.01955	0.00855	0.00000	0.01197
68.	Finance and insurance	0.00696	0.00602	0.00000	0.00843
69.	Real estate and rental	0.00849	0.00359	0.00002	0.00503

TABLE XXIX (Continued)

	Input-Output Sector	Petroleum	Natural Gas	Coal	Electricity
70.	Hotels; personal and repair service except auto	0.03053	0.01341	0.00065	0.01877
71.	Business services	0.02295	0.00442	0.00000	0.00618
72.	Eating and drinking places	0.00035	0.00898	0.00000	0.01257
73.	Automobile repair and services	0.02275	0.00386	0.00000	0.00540
74.	Amusements	0.00638	0.00662	0.00000	0.00927
75.	Health, education and social services and nonprofit organization	0.01514	0.01254	0.00062	0.01756
76.	Federal government enterprise	0.01289	0.01396	0.04259	0.01957
77.	State and local government enterprise	0.05151	0.06697	0.02342	0.09378
78.	Petroleum products production	0.12996	0.01462	0.00087	0.01445
79.	Natural gas production	0.05787	0.10309	0.07839	0.13662
80.	Coal mining	0.02724	0.00989	0.22939	0.01359
81.	Electricity and hydropower	0.13463	0.16466	0.10127	0.17095

water supply and sanitary services (sector 66) and natural gas production (sector 79) were the three highest electricity consumers in Rest of U.S. Electricity and hydropower (sector 81) spent 17.10 cents on electricity, while water supply and sanitary services (sector 66) and natural gas production (sector 79) spent 14.94 cents and 13.66 cents on electricity and hydropower to produce one dollar of output, respectively.

Energy Trade Coefficients

Trade coefficients for the energy processing sectors of the interregional input-output model were estimated directly from the Oklahoma and Rest of U.S. energy balance statements in 1977.

From the Oklahoma energy balance statement (Table XXV), Okahoma exported the following quantities of energy to Rest of U.S. in 1977; 410,235 billion BTUs of petroleum products, 1,021,782 billion BTUs of natural gas, 118,926 billion BTUs of coal and 14,742 billion BTUs of electricity and hydropower.

Energy balance statements by source of energy for U.S. and Rest of U.S. in 1977 are presented in Tables XXX and XXXI. In 1977, U.S. produced 55,181,000 billion BTUs of energy and consumed 73,532,000 billion BTUs. Net import of U.S. energy in 1977 was 18,351,000 billion BTUs. After subtracting Oklahoma energy production and consumption data from U.S. data, the following energy balance statements were obtained for Rest of U.S. in 1977; 52,210,470 billion BTUs for energy production, 72,127,155 billion BTUs for energy consumption, and 19,916,685 billion BTUs for net imports. Energy production in Rest of U.S. in 1977 was as

TABLE XXX

ENERGY BALANCE STATEMENT, U.S. 1977
(BILLION BTUs)

Energy Source	Production	Consumption	Net Export
1. Petroleum Products Production	17,454,000	37,122,000	-19,668,000
2. Natural Gas Production	19,565,000	19,931,300	-366,000
3. Coal	15,829,000	13,964,000	1,865,000
4. Electricity & Hydropower	2,333,000	2,518,000	-182,000
Total Energy	55,181,000	73,532,000	-18,351,000

Source: Department of Energy, Monthly Energy Review, July 1983.

TABLE XXXI

ENERGY BALANCE STATEMENT, REST OF U.S., 1977
(BILLION BTUs)

Energy Source	Production	Consumption	Net Export
1. Petroleum Products Production	16,546,985	36,625,220	-20,078,235
2. Natural Gas Production	17,758,321	19,146,103	-1,387,782
3. Coal	15,696,647	13,950,573	1,746,074
4. Electricity & Hydropower	2,208.517	2,405,259	-196,742
Total Energy	52,210,470	72,127,155	-19,916,685

Source: Computed from Tables XXII and XXX.

follows: 16,546,985 billion BTUs for petroleum products, 17,758,321 billion BTUs for natural gas, 15,696,647 billion BTUs for coal and 2,208,517 billion BTUs for electricity and hydropower. The energy consumption in Rest of U.S. was estimated as follows: 36,625,220 billion BTUs for petroleum products, 19,146,103 billion BTUs for natural gas, 13,950,573 billion BTUs for coal and 2,405,259 billion BTUs for electricity and hydropower.

Estimates of the 1977 energy trade coefficients for the interregional input-output model are presented in Table XXXII. In 1977, the share of Oklahoma's energy exports to total energy consumption of Rest of U.S. were as follows: 1.12 percent for petroleum products, 5.33 percent for natural gas, 0.85 percent for coal, and 0.61 percent for electricity and hydropower. However, Oklahoma's energy consumption was largely independent of the Rest of U.S. region in 1977.

TABLE XXXII

ENERGY TRADE COEFFICIENT MATRIX, 1977

Energy Source/ Region	Oklahoma-Oklahoma	Rest of U.S.-Oklahoma	Oklahoma-Rest of U.S.	Rest of U.S.-Rest of U.S.
Petroleum Products Production	1.00000	0.00000	0.01120	0.98880
Natural Gas Production	1.00000	0.00000	0.05336	0.94664
Coal	1.00000	0.00000	0.00852	0.99148
Electricity and Hydropower	1.00000	0.00000	0.00612	0.99388

Source: E^timated from Tables XXII and XXXI.

CHAPTER VII

REGIONAL AND INTERREGIONAL MULTIPLIERS

When evaluating public programs and policies, it is often important to know what effect proposed programs and policies will have on sector and region, income and/or employment. The policy analyst may be interested in answers to questions such as: How much additional regional or sector income will be generated by a given policy or program? How many regional jobs will be created? Which industries in the economy will be affected most? Regional and interregional multiplier analysis is a tool that can help answer such questions. The multiplier accounts not only for the effects of the spending outlined in the specific program, but also for the subsequent rounds of spending generated by the initial expenditures.

The Keynesian multiplier is traditionally thought of when considering the notion of a multiplier. This multiplier measures the total effect on the economy resulting from an exogenous change in investment, consumption expenditures, government spending, or foreign exports. It is a very aggregate measure that gives no indication of which industries or regions in the economy are most or least affected by the exogenous change. For example, the policy under investigation may be an attempt to stimulate a particular sector of the economy. In this case, the policy analyst will be interested in how output, income, and employment in that particular sector will be affected by a proposed policy. Using an input-output model, this type of detailed multiplier analysis can be performed.

This chapter presents the empirical results of the regional economic impact analysis using an input-output model. Economic impact multipliers are estimated for output, income, and employment of Oklahoma for the base year 1977. The chapter presents estimates of both regional and interregional input-output multipliers. Results for the Rest of U.S. region are not presented but would be very similar to that of the U.S. as a whole.

Methodology and Data Sources

The methodology for calculation of output, income and employment multipliers was defined in Chapter III for both regional and interregional input-output models. The primary data for the input-output multiplier analysis are: regional technical coefficients (A), interregional input-output coefficients (B), the pattern of household income and consumption by each industrial sector, and the pattern of regional employment by input-output sector. These data sources are contained in Chapters IV and V. Chapter IV provides the data for the regional technical coefficients (A) and the interregional input-output coefficients (B) which are required for the calculation of the direct and indirect coefficients.

To measure the induced impact from a change in final demand through an input-output model it is necessary to close the household sector in the processing matrix. The Leontief inverse including household coefficients provides the direct, indirect, and induced effects of an exogenous change in each of the processing sectors. While the direct household row coefficients represent household income generated during the production of a dollar's worth of output by each sector, direct household column coefficients represent the household consumption pattern of a dollar's worth of household income. The data for household income for Oklahoma and the Rest of U.S. in 1977 were presented in Chapter V. For the purpose of regional economic impact analysis, household row coefficients are defined as the ratio of total labor and proprietor income to total sector output. However, data for household expenditures are not available for Oklahoma. Hence, the Oklahoma household expenditure column coefficients were derived from personal consumption expenditure coefficients of the 1977 U.S. input-output table.

The final data requirements for the regional economic impact analysis are the employment-output coefficients. These data are defined as total wage and salary and proprietor employment per dollar of output.

Output Multipliers

Estimates of output multipliers for both regional and interregional models of Oklahoma in 1977 are presented in Table XXXIII. Type I and Type II multipliers are estimated for each of the input-output models. Output multipliers Type I of the regional input-output model were estimated by summing the column entries of the direct and indirect

TABLE XXXIII

OUTPUT MULTIPLIERS, OKLAHOMA, 1977

Input-Output Sector	Regional Model		Interregional Model	
	Type I	Type II	Type I	Type II
1. Livestock and livestock products	2.69999	4.56611	2.91963	6.20699
2. Crops and other agricultural products	1.62519	2.73346	1.73317	3.48738
3. Forestry and fishery products	1.62940	2.95918	1.85955	4.15029
4. Agricultural, forestry and fishery services	2.07511	5.18357	2.25666	6.96763
5. Iron and ferroalloy ores mining	--	--	--	--
6. Nonferrous metal ores mining	1.57349	3.05380	1.89055	4.58765
7. Stone and clay mining and quarrying	1.50686	2.71676	1.69988	3.74387
8. Chemical and fertilizer mineral mining	1.40525	1.82417	1.51998	2.32894
9. New construction	1.75904	4.71066	2.07950	6.78854
10. Maintenance and repair construction	1.73943	4.40937	1.85237	5.10293
11. Ordnance and accessories	1.64504	2.56406	1.98155	3.92943
12. Food and kindred products	2.41139	4.18641	2.77933	6.03883
13. Tobacco manufacturers	--	--	--	--
14. Broad and narrow fabrics, yarn and thread mills	1.40079	2.26485	2.05023	4.38003
15. Miscellaneous textile goods and floor coverings	1.46980	2.79653	2.18626	5.25907
16. Apparel	1.71515	3.93885	2.42430	6.74889
17. Miscellaneous fabricated textile products	1.41711	2.93310	2.01787	5.21827
18. Lumber and wood products, except containers	1.65732	3.19574	2.01121	4.86406
19. Wood containers	1.45492	4.04348	1.71627	5.84988

TABLE XXXIII (Continued)

Input-Output Sector	Regional Model Type I	Regional Model Type II	Interregional Model Type I	Interregional Model Type II
20. Household furniture	1.63848	3.89580	2.07174	6.06088
21. Other furniture and fixtures	1.49708	3.89426	1.86077	5.86629
22. Paper and allied products, except containers	1.91206	3.41147	2.41999	5.49730
23. Paperboard containers and boxes	1.79955	3.90042	2.49837	6.78283
24. Printing and publishing	1.72940	4.07816	2.08074	6.05312
25. Chemicals and selected chemical products	1.69378	3.02039	1.97248	4.31736
26. Plastics and synthetic materials	1.71662	3.08539	2.24742	5.04382
27. Drugs, cleaning and toilet preparations	1.83618	4.37856	2.15130	6.22410
28. Paints and allied products	1.64757	3.66014	2.37170	6.32268
29. Paving and roofing material	1.27905	2.17907	1.32452	2.65131
30. Rubber and miscellaneous plastic products	1.40613	2.74504	1.94022	4.66822
31. Leather tanning and finishing	2.42928	4.28153	2.61522	4.86862
32. Footwear and other leather products	1.70235	3.92677	2.13601	6.12246
33. Glass and glass products	1.66499	4.36728	1.88791	6.04218
34. Stone and clay products	1.79979	3.96285	2.06267	5.56678
35. Primary iron and steel manufacturing	1.55394	3.56699	2.22954	6.21235
36. Primary nonferrous metal manufacturing	1.55752	3.52924	2.49631	7.08154
37. Metal containers	1.55767	2.84781	2.47160	5.87816
38. Heating, plumbing and structural metal products	1.39228	3.38167	2.01618	5.88236
39. Screw machine products and stamping	1.48237	3.90597	2.07680	6.48570
40. Other fabricated metal products	1.37389	2.89056	1.80940	4.70992
41. Engines and turbines	1.43595	2.07758	2.03585	4.10051

TABLE XXXIII (Continued)

Input-Output Sector	Regional Model		Interregional Model	
	Type I	Type II	Type I	Type II
42. Farm and garden machinery	1.51968	3.33282	2.14331	5.87196
43. Construction and mining machinery	1.50039	3.63138	1.98178	5.84711
44. Materials handling machinery and equipment	1.51594	2.96389	1.98733	4.93887
45. Metal working machinery and equipment	1.44562	3.54327	1.78809	5.37503
46. Special industry machinery and equipment	1.52879	2.93534	1.99716	4.96322
47. General industrial machinery and equipment	1.41701	3.61021	1.87041	5.79300
48. Miscellaneous machinery except electrical	1.42462	3.57933	1.83560	5.63537
49. Office, computing and accounting machines	1.93269	2.89053	2.36374	5.00897
50. Service industry machines	1.46344	3.47216	2.00466	5.80816
51. Electric industrial equipment and apparatus	1.47706	3.50250	2.02416	5.87672
52. Household appliances	1.51160	3.75563	2.09318	6.28569
53. Electric lighting and wiring equipment	1.43128	2.07779	1.88606	3.60270
54. Radio, TV and communication equipment	1.46590	3.07886	1.82564	4.84090
55. Electronic components and accessories	1.46136	2.23544	1.83125	3.77550
56. Miscellaneous electrical machinery and supplies	1.48550	2.66484	1.92450	4.38815
57. Motor vehicles and equipment	1.38284	3.08551	2.94013	5.23626
58. Aircrafts and parts	1.83797	4.95969	1.95484	6.62160
59. Other transportation equipment	1.71694	4.71649	2.54798	8.30068
60. Scientific and controlling instruments	1.37836	3.11219	1.69953	4.73172

TABLE XXXIII (Continued)

Input-Output Sector	Regional Model Type I	Regional Model Type II	Interregional Model Type I	Interregional Model Type II
61. Optical, ophthalmic, and photo equipment	1.45160	2.57078	1.76019	3.92241
62. Miscellaneous manufacturing	1.56315	3.52145	2.06494	5.72671
63. Transportation and warehousing	1.97740	4.26154	2.03210	5.32170
64. Communications, except radio and TV	1.37801	4.21433	1.38685	5.36092
65. Radio and TV broadcasting	1.76466	4.59431	1.95461	6.31246
66. Water supply and sanitary services	1.23945	2.82867	1.24783	3.46721
67. Wholesale and retail trade	1.41790	4.92770	1.41963	6.29426
68. Finance and insurance	1.89523	5.25030	1.89648	6.58912
69. Real estate and rental	1.30150	2.06784	1.38901	2.39730
70. Hotels; personal and repair service except auto	1.63843	3.91417	1.77845	5.22048
71. Business services	2.12825	4.71033	1.86592	5.07606
72. Eating and drinking places	2.53184	4.59055	2.56105	5.64529
73. Automobile repair and services	1.88523	3.99875	2.04661	5.15069
74. Amusements	1.78393	4.43594	1.94685	6.01211
75. Health, educational and social services and nonprofit organizations	1.54549	5.20377	1.66373	6.99128
76. Federal government enterprises	1.60673	4.49344	1.61323	5.37006
77. State and local government enterprises	1.81663	3.90459	1.85865	4.82757
78. Petroleum products production	1.27170	2.47996	1.28365	2.99266
79. Natural gas production	1.32715	4.40372	1.33024	5.59569
80. Coal mining	1.45324	3.21579	1.50103	4.05448
81. Electricity and hydropower	1.83613	3.76027	1.83620	4.50764

matrix $(I-A)^{-1}$ and Type II output multiplier were derived by summing the column entries of the direct, indirect and induced matrix $(I-A_H)^{-1}$. On the other hand, output multipliers Type I of the interregional input-output model were derived by summing the column entries of the interregional direct and indirect matrix $(I-B)^{-1}$ and Type II output multipliers were derived by summing the column entries of the interregional direct, indirect and induced matrix $(I-B_H)^{-1}$.

Output multiplier Type I shows the total change in output from all sectors resulting from a dollar change in final demand for the product of that sector. As an example, the Type I output multipliers for livestock and livestock products are 2.69999 and 2.91963 for the regional and interregional input-output models, respectively. This means that a one dollar change in final demand for livestock and livestock products will cause a change in output of all sectors by $2.70 if this impact is measured by a regional input-output model, and total output of all sectors will be changed by $2.92 if the impact is measured by the interregional input-output model.

Type II output multipliers include the induced effect from changes in total output resulting from increased consumer spending. That is, increased final demand means increased personal consumption expenditures which in part are locally produced. The Type II output multipliers for livestock and livestock products are 4.56611 for the regional model and 6.20699 for the interregional model. This means that the total output impact of a dollar change in final demand is $4.56 for the regional model and $6.21 for the interregional model.

The interregional multipliers are generally larger than the regional multipliers. This is because the interregional model allows the effect of interregional trade feedback to be included in its multipliers while the regional model does not. The interregional trade feedback is defined as the secondary trade effect in the output of one region from an increase in that same region's final demand (95). For example, an increase in the output of livestock and livestock products due to an increase in demand for beef in Oklahoma will lead to an increase in the demand for feed grains from the Rest of U.S. region, and the induced expansion in the export of feed grains in the Rest of U.S. region will have a multiplier effect on its levels of output. Increase in the output of feed grains in Rest of U.S. region will in turn be associated with an increase in the demand for petroleum products produced in Oklahoma. Interregional trade feedback is this secondary trade effect in Oklahoma from an increase in final demand for livestock and livestock products output. Since the regional model cannot measure the interregional trade feedback effect the multipliers are smaller than those of the interregional model.

Another factor that causes the regional multipliers to be smaller than the interregional multipliers is the structural technology difference. The regional model derives its technical coefficients by applying the location quotient technique to the national coefficients while the interregional model derives its technical coefficients by multiplying the trade coefficients to the national coefficients. The location quotient technique always yields smaller technical coefficients since it is measuring only the net effect of interregional trade. Hence, the direct and indirect coefficients and, in turn, the multipliers of the regional model are generally lower than those of the interregional model.

The range of Type I output multipliers among input-output sectors of the regional model is from 1.23945 for water supply and sanitary services (sector 66) to 2.69999 for livestock and livestock products (sector 1). The rank order of highest Type I output multiliers among industries in the regional model is livestock and livestock product (2.69999); eating and drinking places (2.53184); leather tanning and finishing (2.42928); food and kindred products (2.41139); business services (2.12825); agricultural, forestry and fisheries services (2.07511); transportation and warehousing (1.97740); office, computing and accounting machine (1.93269); and paper and allied products except containers (1.91206). The rank order of Type I output multipliers among energy processing sectors of the regional model is electricity and hydropower (1.83613); coal mining (1.45324); natural gas production (1.32715); and petroleum products production (1.27170). The Type I output multiplier for crops and other agricultural products is 1.62519.

Type II output multipliers of the regional model range from 1.82417 (chemical and fertilizer mineral mining) to 5.25030 (finance and insurance). The increase from the Type I multiplier by adding induced impacts differ significantly among sectors. Consequently ranking of Type II multipliers changed significantly from Type I multipliers. Ranking of the highest Type II output multipliers include finance and insurance (5.25030); health, educational and social services, and nonprofit orgnization (5.20377); agricultural, forestry and fishery services (5.18357); aircrafts and parts (4.95969); and wholesale and retail trade (4.92770). Except for chemical and fertilizer mineral mining (sector 8), all Type II multipliers exceed two. The rank order of Type II output multipliers among energy processing sectors is natural gas production (4.40372); electricity and hydropower (3.76027); coal mining (3.21579); and petroleum products production (2.47996). Output multiplier Type II of livestock and livestock products and crops and other agricultural products are 4.56611 and 2.73346.

Type I output multipliers of the interregional input-output model are larger than those of the regional model and range from 1.24783 (water supply and sanitary service) to 2.91963 (livestock and livestock products). Sectors with the highest Type I output multipliers are: livestock and livestock products (2.91963); food and kindred products (2.77933); leather tanning and finishing (2.61522); eating and drinking places (2.56105); other transportation equipment (2.54798); paperboard containers and boxes (2.49837); and primary nonferrous metal manufacturing (2.49631). Among energy processing sectors, the rank order of Type I output multipliers is electricity and hydropower (1.83620); coal mining (1.50103); natural gas production (1.33024); and petroleum products production (1.28365). For crops and other agricultural products, the output multiplier Type I is 1.73317.

The variation in the size of Type II output multipliers among industrial sectors of the interregional model is larger than that of the regional model. The range of Type II multipliers in the interregional model is from 2.29730 (real estate and rental) to 8.30068 (other transportation equipment). The ranking of Type II multipliers also changed significantly from that of the regional model. Other transportation equipment (8.30068); primary nonferrous metal manufacturing (7.08154); health, educational and social services, and nonprofit organizations (6.99128); agricultural, forestry and fishery services (6.95763); new construction (6.78854); paperboard containers and boxes (5.78283); and aircraft and parts (6.62160) are among the highest multipliers. Type II output multipliers for livestock and livestock products (sector 1) and crops and other products (sector 2) are 6.20699 and 3.48738, respectively. The rank order of Type II output multipliers for the energy processing sectors differs from that of Type I multipliers, i.e., natural gas production (5.59569), electricity and hydropower (4.50764), coal mining (4.05448), and petroleum products production (2.99266).

Income Multipliers

Estimates of 1977 income multipliers for the regional and interregional input-output models of Oklahoma are presented in Table XXXIV. Type I income multipliers show the direct and indirect change in Oklahoma income per dollar of change in income of a producing sector. Type II income multipliers include the induced effects of increases in income resulting from increased consumer spending. The Type I income multiplier for livestock and livestock products (sector 1) of the regional model is 3.67045 indicating that for each additional dollar of household income generated from livestock and livestock products output, a total of $3.67 in Oklahoma income is generated from that sector and all interdependent sectors. This assumes that output from all interdependent sectors is over and above what was produced previously. The Type II income multiplier for livestock and livestock products is 6.96134 and includes the induced changes in income from increased consumer expenditures within the state.

TABLE XXXIV

INCOME MULTIPLIERS, OKLAHOMA, 1977

Input-Output Sector	Regional Model Type I	Regional Model Type II	Interregional Model Type I	Interregional Model Type II
1. Livestock and livestock products	3.67045	6.96134	4.59653	10.93988
2. Crops and other agricultural products	2.17983	4.13425	2.47543	5.85256
3. Forestry and fishery products	2.39759	4.54724	2.95572	7.00084
4. Agricultural, forestry and fishery services	1.64489	3.11968	1.78900	4.22233
5. Iron and ferroalloy ores mining	--	--	--	--
6. Nonferrous metal ores mining	1.79632	3.40688	2.34162	5.54726
7. Stone and clay mining and quarrying	1.97838[a]	3.75218[a]	2.39253[a]	5.66574[a]
8. Chemical and fertilizer mineral mining	--	--	--	--
9. New construction	1.51651	2.87621	1.73635	4.10430
10. Maintenance and repair construction	2.07091	3.92767	1.95442	4.62234
11. Ordnance and accessories	12.10114	22.95090	18.27559	43.54759
12. Food and kindred products	3.04209	5.76959	3.96848	9.44981
13. Tobacco manufacturers	--	--	--	--
14. Broad and narrow fabrics, yarn and thread mills	1.94380	3.68659	3.72025	8.86400
15. Miscellaneous textile goods and floor coverings	1.67752	3.18156	2.76345	6.57459
16. Apparel	1.70436	3.23247	2.36003	5.61054
17. Miscellaneous fabricated textile products	1.44620	2.74364	2.17751	5.17136
18. Lumber and wood products, except containers	1.87058	3.54772	2.47577	5.87542
19. Wood containers	1.25707	2.38415	1.44203	3.40619

TABLE XXXIV (Continued)

	Input-Output Sector	Regional Model Type I	Regional Model Type II	Interregional Model Type I	Interregional Model Type II
20.	Household furniture	1.49515	2.83569	1.88983	4.47803
21.	Other furniture and fixtures	1.35349	2.56701	1.62204	3.83582
22.	Paper and allied products, except containers	2.94173	5.57926	4.29604	10.21773
23.	Paperboard containers and boxes	1.59585	3.02667	2.31853	5.50970
24.	Printing and publishing	1.54911	2.93803	1.88181	4.45410
25.	Chemicals and selected chemical products	2.34713	4.45154	2.96717	7.03110
26.	Plastics and synthetic materials	2.02741	3.84517	2.94724	7.00982
27.	Drugs, cleaning and toilet preparations	1.57787	2.99258	1.81605	4.29252
28.	Paints and allied products	1.47162	2.79106	2.06284	4.89398
29.	Paving and roofing material	1.63577	3.10239	1.73797	4.09547
30	Rubber and miscellaneous plastic products	1.52376	2.88995	2.21562	5.25847
31.	Leather tanning and finishing	--[a]	--[a]	--[a]	--[a]
32.	Footwear and other leather products	1.48117	2.80917	1.89348	4.48722
33.	Glass and glass products	1.46073	2.77040	1.62216	3.83095
34.	Stone and clay products	1.77072	3.35833	2.05918	4.86645
35.	Primary iron and steel manufacturing	1.54982	2.93938	2.19015	5.19481
36.	Primary nonferrous metal manufacturing	1.55175	3.94302	2.56889	6.10786
37.	Metal containers	2.48695	4.71672	4.65759	11.10358
38.	Heating, plumbing and structural metal products	1.35272	2.56556	1.87861	4.45431
39.	Screw machine products and stamping	1.33676	2.53528	1.74174	4.12291
40.	Other fabricated metal products	1.44298	2.73673	1.97198	4.67571
41.	Engines and turbines	10.64353	20.07431	24.15390	57.82123

TABLE XXXIV (Continued)

Input-Output Sector	Regional Model		Interregional Model	
	Type I	Type II	Type I	Type II
42. Farm and garden machinery	1.62097	3.07431	2.37425	5.64299
43. Construction and mining machinery	1.48164	2.81007	1.91972	4.55311
44. Materials handling machinery and equipment	1.82540	3.46203	2.65015	6.29888
45. Metal working machinery and equipment	1.40439	2.66355	1.72140	4.07247
46. Special industry machinery and equipment	1.88526	3.57556	2.82616	6.72638
47. General industrial machinery and equipment	1.36035	2.58003	1.74051	4.12365
48. Miscellaneous machinery except electrical	1.34928	2.55902	1.70309	4.03339
49. Office, computing and accounting machines	6.73064	12.76526	13.13330	31.39688
50. Service industry machines	1.49553	2.83640	2.02296	4.79765
51. Electric industrial equipment and apparatus	1.42502	2.70268	1.93737	4.59290
52. Household appliances	1.40368	2.66221	1.87509	4.44417
53. Electric lighting and wiring equipment	7.35795	13.95500	13.83241	33.01902
54. Radio, TV and communication equipment	1.50251	2.84963	2.00716	4.75910
55. Electronic components and accessories	2.70355	5.12753	4.32449	10.29242
56. Miscellaneous electrical machinery and supplies	1.99727	3.78800	2.97329	7.06404
57. Motor vehicles and equipment	1.44739	2.74510	2.00086	4.74567
58. Aircrafts and parts	1.61057	3.05460	1.72541	4.08270
59. Other transportation equipment	1.47015	2.78828	2.01279	4.77599
60. Scientific and controlling instruments	1.37672	2.61107	1.72539	4.08265

TABLE XXXIV (Continued)

Input-Output Sector	Regional Model		Interregional Model	
	Type I	Type II	Type I	Type II
61. Optical, ophthalmic, and photo equipment	1.92434	3.64967	2.65333	6.29703
62. Miscellaneous manufacturing	1.54221	2.92494	2.06515	4.88663
63. Transportation and warehousing	2.02873	3.84768	2.10595	4.96235
64. Communications, except radio and TV	1.19588	2.26809	1.21026	2.84749
65. Radio and TV broadcasting	1.51884	2.88061	1.68986	3.97529
66. Water supply and sanitary services	1.23376	2.33993	1.24493	2.92829
67. Wholesale and retail trade	1.16406	2.20774	1.16869	2.74806
68. Finance and insurance	1.61939	3.07131	1.63579	3.84899
69. Real estate and rental	2.86177	5.61727	2.90830	6.85564
70. Hotels; personal and repair service except auto	1.48376	2.81408	1.61499	3.80982
71. Business services	1.77486	3.93516	1.85778	4.38013
72. Eating and drinking places	3.18758	6.04552	3.40544	8.08671
73. Automobile repair and services	2.39823	4.54845	2.51813	5.96870
74. Amusements	1.50603	2.85632	1.66595	3.92221
75. Health, educational and social services and nonprofit organizations	1.20092	2.27765	1.26232	2.97148
76. Federal government enterprises	1.42563	2.70384	1.38332	3.25449
77. State and local government enterprises	1.98181	3.75868	2.02937	4.78491
78. Petroleum products production	1.35892	2.57731	1.38720	3.26568
79. Natural gas production	1.15694	2.19424	1.15974	2.72662
80. Coal mining	1.42138	2.69577	1.48230	3.49609
81. Electricity and hydropower	3.47068	6.58246	3.48131	8.18929

[a] Less than $100,000 income for Oklahoma in 1977.

Type I income multipliers of the regional model range from 1.15694 (natural gas production) to 12.10114 (ordnance and accessores). There are seven producing sectors with Type I income multipliers exceeding 3.0: ordnance and accessories (12.10114); engines and turbines (10.64353), electric lighting and wiring equipment (7.35795); office, computing and accounting machines (6.73064); livestock and livestock products (3.67045); electricity and hydropower (3.47068); eating and drinking places (3.18758); and food and kindred products (3.04209).

Range of Type II income multipliers for the regional model is from 2.19424 (natural gas production) to 22.95090 (ordnance and accessories). The order of processing sectors with the highest Type II income multipliers is: ordnance and accessories (22.95090); engines and turbines (20.07431); electric lighting and wiring equipment (13.95500); office, computing and accounting machines (13.13300); livestock and livestock products (6.96134); electricity and hydropower (6.58246); eating and drinking places (6.04552); food and kindred products (5.76959); paper and allied products, except containers (5.57926); and real estate and rental (5.61727).

The rank order for the energy processing sectors are the same for Type I and Type II income multipliers of the regional model, i.e., electricity and hydropower (3.47068 for Type I and 6.58246 for Type II), coal mining (1.42138 and 2.69577), petroleum products production (1.35892 and 2.57731), and natural gas production (1.15694 and 2.19424), respectively.

The range of Type I income multipliers of the interregional model is from 1.15974 for natural gas production to 24.15390 for engines and turbines. Type I sector multipliers approximately equal to or are greater than five are: engines and turbines (24.15390), ordnance and accessories (18.27559), electric lighting and wiring equipment (13.83421); office computing and accounting machine (13.13330); and livestock and livestock products (4.59653).

The induced impacts on income multipliers from the interregional model vary among industries. The range of Type II multipliers is from 2.72662 (natural gas production) to 57.82123 (engines and turbines). In addition to engines and turbines, sectors with large Type II income multipliers are: ordnance and accessories (43.54759); electric lighting and wiring equipment (33.01902); office, computing and accounting machines (31.39688); metal containers (11.10358); livestock and livestock products (10.93988); electronic components and accessories (10.29242); and paper and allied products, except containers (10.21773). The rank order of income multipliers for the energy processing sectors is electricity and hydropower (8.18929); coal mining (3.49609); petroleum products production (3.26568); and natural gas production (2.72662), respectively.

Employment Multipliers

Estimates of Type I and Type II employment multipliers for Oklahoma in 1977 from both a regional and an interregional input-output model are presented in Table XXXV. These employment multipliers were computed using the 1977 employment-output coefficients and the interdependence coefficients. The Type I multiplier shows the direct and indirect employment effect for a one unit change in the direct employment effect. As an example, the Type I employment multiplier for food and kindred

TABLE XXXV

EMPLOYMENT MULTIPLIERS, OKLAHOMA, 1977

Input-Output Sector	Regional Model		Interregional Model	
	Type I	Type II	Type I	Type II
1. Livestock and livestock products	2.15073	3.86460	2.32107	4.48525
2. Crops and other agricultural products	1.29061	1.79458	1.29472	2.09948
3. Forestry and fishery products	1.80012	3.16426	1.91772	4.29051
4. Agricultural, forestry and fishery services	1.67647	3.08250	1.65950	3.80285
5. Iron and ferroalloy ores mining	--	--	--	--
6. Nonferrous metal ores mining	1.44954	2.67723	1.60032	3.85910
7. Stone and clay mining and quarrying	2.01855[a]	4.05048[a]	2.20027[a]	5.66606[a]
8. Chemical and fertilizer mineral mining	--	--	--	--
9. New construction	1.75308	3.92836	1.89755	5.39835
10. Maintenance and repair construction	2.02961	5.46253	2.13512	6.02977
11. Ordnance and accessories	1.54279	2.13353	1.65849	2.93141
12. Food and kindred products	4.31634	9.23259	4.83218	12.11219
13. Tobacco manufacturers	--	--	--	--
14. Broad and narrow fabrics, yarn and thread mills	1.75743	2.91794	2.40899	5.57754
15. Miscellaneous textile goods and floor coverings	1.61860	2.93402	2.15721	5.24004
16. Apparel	1.72423	3.15686	2.12753	4.94578
17. Miscellaneous fabricated textile products	1.51558	2.92969	2.01296	5.03121
18. Lumber and wood products, except containers	1.92286	3.81893	2.28014	5.83372
19. Wood containers	1.61209	4.58699	1.86814	6.65856

TABLE XXXV (Continued)

	Input-Output Sector	Regional Model Type I	Regional Model Type II	Interregional Model Type I	Interregional Model Type II
20.	Household furniture	1.45540	2.73144	1.65561	3.92304
21.	Other furniture and fixtures	1.49481	3.31777	1.68605	4.75939
22.	Paper and allied products, except containers	3.45248	7.72724	4.50979	13.38616
23.	Paperboard containers and boxes	1.75791	3.94305	2.31243	6.81926
24.	Printing and publishing	1.67219	3.37923	1.85527	4.77729
25.	Chemicals and selected chemical products	3.94272	10.41811	4.72198	16.28162
26.	Plastics and synthetic materials	1.06847	1.22158	1.10426	1.42075
27.	Drugs, cleaning and toilet preparations	2.80644	6.28023	2.99169	8.61108
28.	Paints and allied products	2.08338	5.29274	2.71886	9.08568
29.	Paving and roofing material	1.78457	4.24332	1.83053	5.48133
30.	Rubber and miscellaneous plastic products	1.85111	4.10826	2.38601	7.03421
31.	Leather tanning and finishing	--[a]	--[a]	--[a]	--[a]
32.	Footwear and other leather products	1.32768	2.18423	1.44591	2.99240
33.	Glass and glass products	1.64026	3.92169	1.75960	5.31482
34.	Stone and clay products	1.96909	4.47249	2.16382	6.25434
35.	Primary iron and steel manufacturing	1.87387	4.64472	2.47220	8.01342
36.	Primary nonferrous metal manufacturing	1.76444	4.27268	2.43206	8.33253
37.	Metal containers	2.17538	4.39244	3.18426	9.11370
38.	Heating, plumbing and structural metal products	1.58108	3.89369	2.04926	6.58966
39.	Screw machine products and stamping	1.29981	2.76938	1.53944	4.23802
40.	Other fabricated metal products	1.48839	3.10874	1.78244	4.91297
41.	Engines and turbines	4.69566	9.19688	7.54205	22.24147

TABLE XXXV (Continued)

	Input-Output Sector	Regional Model		Interregional Model	
		Type I	Type II	Type I	Type II
42.	Farm and garden machinery	1.76533	3.81292	2.22820	6.48703
43.	Construction and mining machinery	1.85704	4.77312	2.28133	7.62565
44.	Materials handling machinery and equipment	1.66333	3.37434	2.02185	5.54945
45.	Metal working machinery and equipment	1.70833	4.48452	2.00750	6.79824
46.	Special industry machinery and equipment	2.49824	5.92774	3.29064	10.60923
47.	General industrial machinery and equipment	1.55847	3.77003	1.85112	5.84557
48.	Miscellaneous machinery except electrical	1.44397	3.19743	1.66192	4.78399
49.	Office, computing and accounting machines	2.58694	3.90217	3.08759	6.77145
50.	Service industry machines	1.68769	3.97844	2.10675	6.48920
51.	Electric industrial equipment and apparatus	1.57767	3.32929	1.90513	5.27074
52.	Household appliances	--[a]	--[a]	--[a]	--[a]
53.	Electric lighting and wiring equipment	1.86926	2.93499	2.38599	5.25395
54.	Radio, TV and communication equipment	2.00211	4.40592	2.42575	6.96546
55.	Electronic components and accessories	1.76083	2.85729	2.13832	4.63523
56.	Miscellaneous electrical machinery and supplies	1.84734	3.60197	2.24423	5.95079
57.	Motor vehicles and equipment	1.84250	4.75949	2.46103	8.16501
58.	Aircrafts and parts	1.87420	4.94809	1.97347	6.30949
59.	Other transportation equipment	1.49459	3.12917	1.80547	4.95966
60.	Scientific and controlling instruments	1.81104	4.40108	2.13750	6.70894

TABLE XXXV (Continued)

Input-Output Sector	Regional Model		Interregional Model	
	Type I	Type II	Type I	Type II
61. Optical, ophthalmic, and photo equipment	3.01124	6.75337	3.74815	11.05512
62. Miscellaneous manufacturing	1.54505	2.88122	1.76595	4.28969
63. Transportation and warehousing	2.03108	4.30172	2.05691	5.29260
64. Communications, except radio and TV	1.36511	3.84391	1.43177	4.78632
65. Radio and TV broadcasting	2.32911	4.88153	2.76467	6.72070
66. Water supply and sanitary services	1.40958	4.79676	1.58373	6.06284
67. Wholesale and retail trade	1.09577	2.23191	1.18378	2.63172
68. Finance and insurance	1.72292	3.93895	1.87861	4.71673
69. Real estate and rental	3.11529	7.10346	3.26035	8.18748
70. Hotels; personal and repair service except auto	1.33350	2.12762	1.35951	2.56994
71. Business services	1.24475	2.32413	1.38042	2.35664
72. Eating and drinking places	1.45968	2.38757	1.52382	2.62627
73. Automobile repair and services	1.76043	3.63256	1.82134	4.30194
74. Amusements	1.40827	2.18500	1.49804	2.69677
75. Health, educational and social services and nonprofit organizations	1.44311	3.56165	1.47960	4.58554
76. Federal government enterprises	1.72770	4.96237	1.75085	5.85356
77. State and local government enterprises	1.87887	4.27372	1.97324	5.19062
78. Petroleum products production	1.56170	4.58903	1.65195	5.82041
79. Natural gas production	1.25448	4.57611	1.33798	5.83182
80. Coal mining	2.82045	9.61570	2.89097	12.81087
81. Electricity and hydropower	3.36282	9.79893	3.47727	12.19049

[a]Less than 100 employed in Oklahoma, 1977.

products (sector 12) for the regional model is 4.31634. This means that each person directly employed in the food and kindred products manufacturing sector is associated with 3.31634 additional persons employed in sectors interdependent with food and kindred products.

Type II employment multipliers include the induced effect from changes in income resulting from increased consumer spending. That is, increased employment means increased personal consumption expenditures which in part are produced locally. The Type II employment multiplier of food and kindred products is 9.23259 which means the total employment impact from all interdependent sectors.

Type I employment multipliers of the regional input-output model range from 1.06847 (plastics and synethetic materials) to 4.69566 (engines and turbines). In addition to engines and turbines, food and kindred products (4.31634); chemical and selected chemical products (3.94272); paper and allied products, except containers (3.45248); real estate and rental (3.11529); and optical, opthalmic, and photo equipment (3.01124) show high employment multipliers. Type I employment multipliers for the energy processing sectors are ranked from highest to lowest as electricity and hydropower (3.36282); coal mining (2.82045); petroleum products production (1.56170); and natural gas production (1.25448).

Type II employment multipliers of the regional model are from 1.22158 (plastics and synthetic materials) to 10.41811 (chemicals and selected chemical products). Other sectors with high Type II employment multipliers are electricity and hydropower (9.79893); coal mining (9.61570); food and kindred products (9.23259); engines and turbines

(9.19688); paper and allied products, except containers (7.72724); and real estate and rental (7.10346). Type II employment multipliers of other energy processing sectors are 4.58903 for petroleum products production and 4.57611 for natural gas production.

Type I employment multipliers of the interregional model range from 1.10426 to 7.54205, while the range of Type II employment multipliers is from 1.42075 to 22.24147. Plastics and synthetic materials has the smallest multiplier and engines and turbines has the largest multiplier for both Type I and II. The following sectors show the highest Type I multipliers: engines and turbines (7.54205); food and kindred products (4.83218); chemicals and selected chemical products (4.72198); and paper and allied products, except containers (4.50979). All other sectors have Type I multipliers less than four. There are eight industrial sectors which have Type II employment multipliers exceeding ten: engines and turbines (22.24147); chemicals and selected chemical products (16.28162); paper and allied products, except containers (13.38616); coal mining (12.81087); electricity and hydropower (12.19049); food and kindred products (12.11219); optical, ophthalmic, and photographic equipment (11.05512); and special industry machinery and equipment (10.60923). The rank order of employment multipliers of the energy processing sectors is electricity and hydropower (3.47727 for Type I and 12.19049 for Type II); coal mining (2.89097 and 12.81087), petroleum products production (1.65195 and 5.82041), and natural gas production (1.33798 and 5.83182).

CHAPTER VIII

EMPIRICAL RESULTS OF THE INTERREGIONAL INPUT-OUTPUT PRICE MODELS

Introduction

This chapter presents the empirical results of the interregional input-output price model. The truncated interregional input-output price model is tested using an 81 industry, two region, aggregation of the data. The industrial classifications are explained in Table VII of Chapter IV. Data for an 81 industry, two region input-output model are explained in Chapter IV. Data for energy processing sectors are taken from the energy accounts of Chapter VI. First, the price of petroleum products for 1977 was hypothetically increased by 20 percent throughout the United States to determine what impacts this uniform price change would have on other sector prices. Prices of all other energy processing sectors are then increased by 20 percent, one at a time, throughout the entire nation to compare impacts on commodity prices. Finally, all energy prices are assumed to increase simultaneously by 20 percent. The truncated interregional input-output price model is also used to estimate impacts of actual real price changes in petroleum products and natural gas in Oklahoma and Rest of U.S. between the period 1977-81.

Effects of Energy Price Changes in Truncated Interregional Input-Output Model

Impacts of 20 Percent Increase in Energy Prices

Estimated impacts of a 20 percent increase in various energy prices throughout the United States on other commodity prices in Oklahoma are presented in Table XXXVI. The results of a 20 percent increase in petroleum prices are presented in the first column of data in Table XXXVI. Transportation and warehousing (sector 63) was impacted most in Oklahoma with an increase of about 5.65 percent over the normalized price. Almost all industries in Oklahoma were affected by this petroleum product price change. Five other sectors in Oklahoma had price increases of more than two percent. They are paper and allied products, except container (sector 22); agricultural, forestry, and fishery services (sector 4); forestry and fishery products (sector 3); crops and other agricultural products (sector 2); and chemical and selected chemical products (sector 25). These price increases range between 2.12 percent and 2.76 percent. Nine other sectors had price increases of more than one percent. They were nonferrous metal ores mining (sector 6); chemical and fertilizer mineral mining (sector 8); livestock and livestock products (sector 1); leather tanning and finishing (sector 31); screw machine products and stamping (sector 39); paperboard containers and boxes (sector 23); stone and clay products (sector 34); plastics and synthetic materials (sector 26); and primary iron and steel manufacturing (sector 35). These price increases ranged from 1.01 to 1.92 percent.

TABLE XXXVI

OKLAHOMA COMMODITY PRICE CHANGES FROM 20 PERCENT INCREASE IN ENERGY PRICES THROUGHOUT THE UNITED STATES (1977 DOLLARS)

	Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
1.	Livestock and livestock products	1.0138	1.0043	1.0007	1.0037	1.0186
2.	Crops and other agricultural products	1.0213	1.0034	1.0004	1.0027	1.0253
3.	Forestry and fishery products	1.0215	1.0076	1.0006	1.0058	1.0317
4.	Agricultural, forestry and fishery services	1.0228	1.0111	1.0006	1.0086	1.0379
5.	Iron and ferroalloy ores mining	--	--	--	--	--
6.	Nonferrous metal ores mining	1.0192	1.0106	1.0011	1.0172	1.0398
7.	Stone and clay mining and quarrying	1.0094	1.0034	1.0008	1.0047	1.0154
8.	Chemical and fertilizer mineral mining	1.1089	1.0036	1.0005	1.0073	1.0265
9.	New construction	1.0095	1.0048	1.0014	1.0036	1.0161
10.	Maintenance and repair construction	1.0099	1.0031	1.0008	1.0029	1.0142
11.	Ordnance and accessories	1.0079	1.0089	1.0012	1.0117	1.0241
12.	Food and kindred products	1.0092	1.0044	1.0009	1.0043	1.0149
13.	Tobacco manufacturers	--	--	--	--	--
14.	Broad and narrow fabrics, yarn and thread mills	1.0065	1.0045	1.0008	1.0066	1.0144
15.	Miscellaneous textile goods and floor coverings	1.0055	1.0049	1.0009	1.0045	1.0124
16.	Apparel	1.0050	1.0035	1.0006	1.0028	1.0079
17.	Miscellaneous fabricated textile products	1.0042	1.0026	1.0006	1.0028	1.0079
18.	Lumber and wood products, except containers	1.0093	1.0047	1.0008	1.0048	1.0160
19.	Wood containers	1.0095	1.0036	1.0008	1.0041	1.0150

TABLE XXXVI (Continued)

	Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
20.	Household furniture	1.0060	1.0032	1.0010	1.0035	1.0106
21.	Other furniture and fixture	1.0052	1.0033	1.0014	1.0030	1.0104
22.	Paper and allied products, except containers	1.0276	1.0143	1.0015	1.0119	1.0476
23.	Paperboard containers and boxes	1.0118	1.0080	1.0022	1.0073	1.0233
24.	Printing and publishing	1.0056	1.0036	1.0010	1.0044	1.0115
25.	Chemical and selected chemical products	1.0212	1.0151	1.0009	1.0126	1.0429
26.	Plastics and synthetic materials	1.0109	1.0070	1.0015	1.0075	1.0214
27.	Drugs, cleaning and toilet preparations	1.0086	1.0037	1.0008	1.0041	1.0141
28.	Paints and allied products	1.0086	1.0057	1.0016	1.0055	1.0164
29.	Paving and roofing material	1.0010	1.0070	1.0002	1.0031	1.0183
30.	Rubber and miscellaneous plastic products	1.0059	1.0048	1.0010	1.0134	1.0089
31.	Leather tanning and finishing	1.0128	1.0065	1.0008	1.0052	1.0211
32.	Footwear and other leather products	1.0056	1.0042	1.0007	1.0056	1.0126
33.	Glass and glass products	1.0086	1.0095	1.0007	1.0093	1.0232
34.	Stone and clay products	1.0118	1.0103	1.0044	1.0095	1.0303
35.	Primary iron and steel manufacturing	1.0101	1.0088	1.0034	1.0130	1.0281
36.	Primary nonferrous metal manufacturing	1.0079	1.0107	1.0015	1.0186	1.0291
37.	Metal containers	1.0086	1.0133	1.0045	1.0078	1.0280
38.	Heating, plumbing and structural metal products	1.0052	1.0038	1.0030	1.0040	1.0124
39.	Screw machine products and stamping	1.0120	1.0103	1.0031	1.0161	1.0336
40.	Other fabricated metal products	1.0049	1.0036	1.0017	1.0046	1.0117
41.	Engines and turbines	1.0056	1.0056	1.0022	1.0060	1.0153
42.	Farm and garden machinery	1.0060	1.0041	1.0026	1.0040	1.0131
43.	Construction and mining machinery	1.0044	1.0039	1.0024	1.0039	1.0114

TABLE XXXVI (Continued)

Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
44. Materials handling machinery and equipment	1.0047	1.0071	1.0023	1.0149	1.0218
45. Metal working machinery and equipment	1.0053	1.0089	1.0016	1.0119	1.0221
46. Special industry machinery and equipment	1.0044	1.0038	1.0020	1.0036	1.0106
47. General industrial machinery and equipment	1.0042	1.0035	1.0021	1.0037	1.0103
48. Miscellaneous machinery except electrical	1.0044	1.0033	1.0017	1.0036	1.0101
49. Office, computing and accounting machines	1.0045	1.0030	1.0010	1.0031	1.0089
50. Service industry machines	1.0046	1.0094	1.0018	1.0035	1.0160
51. Electric industrial equipment and apparatus	1.0045	1.0036	1.0016	1.0040	1.0106
52. Household appliances	1.0092	1.0040	1.0018	1.0159	1.0169
53. Electric lighting and wiring equipment	1.0056	1.0070	1.0012	1.0080	1.0175
54. Radio, TV and communication equipment	1.0028	1.0020	1.0006	1.0021	1.0058
55. Electronic components and accessories	1.0041	1.0047	1.0007	1.0130	1.0104
56. Miscellaneous electrical machinery and supplies	1.0087	1.0069	1.0009	1.0206	1.0151
57. Motor vehicles and equipment	1.0042	1.0050	1.0015	1.0052	1.0126
58. Aircrafts and parts	1.0036	1.0026	1.0008	1.0032	1.0080
59. Other transportation equipment	1.0081	1.0060	1.0028	1.0062	1.0182
60. Scientific and controlling instruments	1.0034	1.0030	1.0007	1.0038	1.0086
61. Optical, ophthalmic, and photo equipment	1.0037	1.0036	1.0008	1.0040	1.0095
62. Miscellaneous manufacturing	1.0055	1.0035	1.0011	1.0040	1.0111
63. Transportation and warehousing	1.0565	1.0058	1.0003	1.0024	1.0613
64. Communications, except radio and TV	1.0012	1.0011	1.0001	1.0020	1.0035
65. Radio and TV broadcasting	1.0022	1.0029	1.0002	1.0069	1.0095
66. Water supply and sanitary services	1.0012	1.0019	1.0001	1.0041	1.0057
67. Wholesale and retail trade	1.0017	1.0018	1.0001	1.0033	1.0055

TABLE XXXVI (Continued)

	Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
68.	Finance and insurance	1.0018	1.0014	1.0002	1.0019	1.0043
69.	Real estate and rental	1.0014	1.0007	1.0001	1.0008	1.0025
70.	Hotels; personal and repair services except auto	1.0024	1.0023	1.0003	1.0031	1.0065
71.	Business services	1.0037	1.0035	1.0003	1.0054	1.0105
72.	Eating and drinking places	1.0060	1.0042	1.0006	1.0062	1.0133
73.	Automobile repair and services	1.0035	1.0091	1.0008	1.0050	1.0153
74.	Amusements	1.0031	1.0035	1.0002	1.0066	1.0106
75.	Health, education and social services and nonprofit organization	1.0023	1.0028	1.0002	1.0032	1.0069
76.	Federal government enterprises	1.0078	1.0095	1.0002	1.0101	1.0233
77.	State and local government enterprises	1.0046	1.0108	1.0005	1.0123	1.0229
78.	Petroleum products production	1.2000	1.0058	1.0002	1.0033	1.2000
79.	Natural gas production	1.0072	1.2000	1.0001	1.0048	1.2000
80.	Coal mining	1.0069	1.0039	1.2000	1.0094	1.2000
81.	Electricity and hydropower	1.0044	1.0624	1.0015	1.2000	1.2000

With a natural gas price increase of 20 percent, electricity and hydropower (sector 81) was impacted most in Oklahoma with an increase of 6.24 percent over normalized price. Nine other processing sectors in Oklahoma showed increases in commodity prices by more than one percent (column 2 of Table XXXVI). They were chemical and selected chemical products (sector 25); paper and allied product, except containers (sector 22); metal containers (sector 37); agricultural, forestry, and fishery services (sector 4); state and local government enterprises (sector 77); primary nonferrous metal manufacturing (sector 36); nonferrous metal ores mining (sector 6); stone and clay products (sector 34); and screw machine products and stamping (sector 39). These price increases range from 1.03 to 1.51 percent.

When the coal price was increased by 20 percent, prices of all other commodities increased by less than one percent (column 3 of Table XXXVI). When electricity and hydropower price was increased by 20 percent, 11 processing sectors in Oklahoma showed price increases of slightly more than one percent, while all other sectors showed price increases of less than one percent (column 4 of Table XXXVI). These sectors were primary nonferrous metal manufacturing (sector 36); nonferrous metal ores mining (sector 6); screw machine products and stamping (sector 39); materials handling machinery and equipment (sector 44); primary iron and steel manufacturing (sector 35); chemical and selected chemical products (sector 25); state and local government enterprises (sector 77); paper and allied products, except containers (sector 22); metal working machinery and equipment (sector 45); ordnance and accessories (sector 11); and federal government enterprises (sector 76).

When all energy prices were increased by 20 percent at the same time, prices of transportation and warehousing (sector 63); paper and allied products, except containers (sector 22); chemical and selected chemical products (sector 25); nonferrous metal ores mining (sector 6); agricultural, forestry and fishery services (sector 4); screw machine products and stamping (sector 39); forestry and fishery products (sector 3); and stone and clay products (sector 34) of Oklahoma increased most ranging from 3.03 to 6.13 percent (column 5 of Table XXXVI). All other sectors in Oklahoma also showed price increases. Prices of livestock and livestock products (sector 1) and crops and other agricultural products (sector 2) increased by 1.86 percent and 2.53 percent, respectively. Increases in prices of other commodities ranged from 0.25 percent for real estate and rental (sector 69) to 2.91 percent for primary nonferrous metal manufacturing (sector 36).

Impacts from a 20 percent increase in the various energy prices on Rest of U.S. commodity prices are presented in Table XXXVII. When petroleum product prices were increased by 20 percent, sectors that were most affected are paving and roofing materials (sector 29); stone and clay mining and quarrying (sector 7); water supply and sanitary services (sector 66); forestry and fishery products (sector 3); electricity and hydropower (sector 81); natural gas production (sector 79); agricultural, forestry and fishery services (sector 4); and transportation and warehousing (sector 63). The price increases ranged from 2.40 to 7.48 percent. All other commodity prices increased by less than two percent. Livestock and livestock product prices increased by 1.25 percent, while prices of crops and other agricultural products increased by 1.21 percent.

TABLE XXXVII

REST OF U.S. COMMODITY PRICE CHANGES FROM 20 PERCENT INCREASE IN ENERGY PRICES THROUGHOUT THE UNITED STATES (1977 DOLLARS)

	Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
1.	Livestock and livestock products	1.0125	1.0061	1.0012	1.0044	1.0179
2.	Crops and other agricultural products	1.0121	1.0046	1.0008	1.0026	1.0151
3.	Forestry and fishery products	1.0412	1.0113	1.0016	1.0036	1.0436
4.	Agricultural, forestry and fishery services	1.0252	1.0083	1.0016	1.0062	1.0307
5.	Iron and ferroalloy ores mining	1.0149	1.0146	1.0050	1.0137	1.0351
6.	Nonferrous metal ores mining	1.0197	1.0167	1.0034	1.0151	1.0397
7.	Stone and clay mining and quarrying	1.0471	1.0254	1.0050	1.0187	1.0709
8.	Chemical and fertilizer mineral mining	1.0099	1.0096	1.0022	1.0090	1.0221
9.	New construction	1.0100	1.0047	1.0017	1.0031	1.0145
10.	Maintenance and repair construction	1.0193	1.0068	1.0014	1.0032	1.0230
11.	Ordnance and accessories	1.0056	1.0045	1.0019	1.0040	1.0118
12.	Food and kindred products	1.0095	1.0055	1.0014	1.0043	1.0153
13.	Tobacco manufacturers	1.0087	1.0044	1.0009	1.0025	1.0123
14.	Broad and narrow fabrics, yarn and thread mills	1.0059	1.0048	1.0014	1.0042	1.0119
15.	Miscellaneous textile goods and floor coverings	1.0064	1.0054	1.0014	1.0047	1.0130
16.	Apparel	1.0063	1.0045	1.0011	1.0039	1.0116
17.	Miscellaneous fabricated textile products	1.0045	1.0034	1.0009	1.0029	1.0085
18.	Lumber and wood products, except containers	1.0146	1.0059	1.0020	1.0035	1.0195
19.	Wood containers	1.0089	1.0042	1.0012	1.0029	1.0127

TABLE XXXVII (Continued)

	Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
20.	Household furniture	1.0072	1.0043	1.0014	1.0033	1.0120
21.	Other furniture and fixtures	1.0061	1.0042	1.0021	1.0035	1.0119
22.	Paper and allied products, except containers	1.0128	1.0087	1.0041	1.0072	1.0244
23.	Paperboard containers and boxes	1.0115	1.0071	1.0026	1.0056	1.0198
24.	Printing and publishing	1.0062	1.0041	1.0014	1.0034	1.0112
25.	Chemicals and selected chemical products	1.0094	1.0087	1.0030	1.0075	1.0209
26.	Plastics and synthetic materials	1.0101	1.0081	1.0029	1.0068	1.0205
27.	Drugs, cleaning and toilet preparations	1.0085	1.0048	1.0013	1.0036	1.0135
28.	Paints and allied products	1.0128	1.0072	1.0020	1.0052	1.0201
29.	Paving and roofing materials	1.0748	1.0516	1.0048	1.0077	1.1052
30.	Rubber and miscellaneous plastic products	1.0054	1.0033	1.0012	1.0025	1.0092
31.	Leather tanning and finishing	1.0089	1.0052	1.0015	1.0040	1.0145
32.	Footwear and other leather products	1.0053	1.0035	1.0010	1.0028	1.0092
33.	Glass and glass products	1.0085	1.0089	1.0020	1.0086	1.0201
34.	Stone and clay products	1.0154	1.0108	1.0047	1.0091	1.0296
35.	Primary iron and steel manufacturing	1.0105	1.0100	1.0123	1.0093	1.0323
36.	Primary nonferrous metal manufacturing	1.0102	1.0100	1.0023	1.0091	1.0226
37.	Metal containers	1.0077	1.0067	1.0050	1.0060	1.0190
38.	Heating, plumbing and structural metal products	1.0061	1.0050	1.0036	1.0044	1.0143
39.	Screw machine products and stamping	1.0056	1.0048	1.0035	1.0044	1.0137
40.	Other fabricated metal products	1.0054	1.0045	1.0022	1.0040	1.0118
41.	Engines and turbines	1.0056	1.0046	1.0026	1.0040	1.0125
42.	Farm and garden machinery	1.0067	1.0049	1.0031	1.0041	1.0140
43.	Construction and mining machinery	1.0069	1.0108	1.0033	1.0041	1.0189

TABLE XXXVII (Continued)

	Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
44.	Materials handling machinery and equipment	1.0054	1.0045	1.0026	1.0039	1.0122
45.	Metal working machinery and equipment	1.0067	1.0044	1.0020	1.0035	1.0123
46.	Special industry machinery and equipment	1.0083	1.0053	1.0025	1.0042	1.0151
47.	General industrial machinery and equipment	1.0128	1.0085	1.0029	1.0043	1.0214
48.	Miscellaneous machinery, except electrical	1.0097	1.0057	1.0025	1.0044	1.0166
49.	Office, computing and accounting machines	1.0054	1.0039	1.0013	1.0033	1.0102
50.	Service industry machines	1.0062	1.0044	1.0022	1.0037	1.0122
51.	Electric industrial equipment and apparatus	1.0074	1.0054	1.0022	1.0046	1.0144
52.	Household appliances	1.0054	1.0044	1.0022	1.0039	1.0118
53.	Electric lighting and wiring equipment	1.0044	1.0038	1.0016	1.0034	1.0097
54.	Radio, TV and communication equipment	1.0037	1.0029	1.0009	1.0026	1.0073
55.	Electronic components and accessories	1.0045	1.0037	1.0011	1.0033	1.0092
56.	Miscellaneous electrical machinery and supplies	1.0048	1.0046	1.0017	1.0078	1.0132
57.	Motor vehicles and equipment	1.0040	1.0031	1.0018	1.0027	1.0087
58.	Aircraft and parts	1.0055	1.0038	1.0012	1.0032	1.0100
59.	Other transportation equipment	1.0099	1.0067	1.0034	1.0054	1.0190
60.	Scientific and controlling instruments	1.0082	1.0052	1.0013	1.0042	1.0138
61.	Optical, ophthalmic and photo equipment	1.0049	1.0034	1.0014	1.0028	1.0093
62.	Miscellaneous manufacturing	1.0081	1.0049	1.0016	1.0039	1.0136
63.	Transportation and warehousing	1.0240	1.0080	1.0012	1.0036	1.0276
64.	Communications, except radio and TV	1.0026	1.0023	1.0005	1.0022	1.0055
65.	Radio and TV broadcasting	1.0049	1.0045	1.0009	1.0042	1.0104
66.	Water supply and sanitary services	1.0437	1.0457	1.0253	1.0344	1.1114
67.	Wholesale and retail trade	1.0066	1.0042	1.0008	1.0035	1.0110

TABLE XXXVII (Continued)

	Input-Output Sector	Petroleum Products (1)	Natural Gas (2)	Coal (3)	Electricity (4)	All Energy (5)
68.	Finance and insurance	1.0052	1.0040	1.0010	1.0035	1.0100
69.	Real estate and rental	1.0046	1.0024	1.0005	1.0018	1.0068
70.	Hotels; personal and repair service except auto	1.0108	1.0071	1.0015	1.0058	1.0183
71.	Business services	1.0089	1.0044	1.0010	1.0031	1.0128
72.	Eating and drinking places	1.0071	1.0058	1.0013	1.0052	1.0140
73.	Automobile repair and services	1.0083	1.0043	1.0012	1.0031	1.0125
74.	Amusements	1.0058	1.0042	1.0008	1.0037	1.0105
75.	Health, education and social services and nonprofit organization	1.0072	1.0057	1.0013	1.0051	1.0140
76.	Federal government enterprises	1.0083	1.0062	1.0096	1.0053	1.0230
77.	State and local government enterprises	1.0227	1.0230	1.0089	1.0219	1.0557
78.	Petroleum products production	1.2000	1.0488	1.0049	1.0103	1.2000
79.	Natural gas production	1.0371	1.2000	1.0164	1.0118	1.2000
80.	Coal mining	1.0105	1.0064	1.2000	1.0039	1.2000
81.	Electricity and hydropower	1.0402	1.0436	1.0226	1.2000	1.2000

When the natural gas price was increased by 20 percent, prices of the following sectors in Rest of U.S. were most affected: paving and roofing materials (sector 29); petroleum products production (sector 78); water supply and sanitary services (sector 66); electricity and hydropower (sector 81); and stone and clay mining and quarrying (sector 7), with price increases ranging from 2.54 to 5.16 percent. All other commodity prices increased by less than two percent.

When the coal price was increased by 20 percent, only four processing sectors in Rest of U.S. showed price increases by more than one percent. They are water supply and sanitary services (sector 66); electricity and hydropower (sector 81); natural gas production (sector 79); and primary iron and steel manufacturing (sector 35); with price increases of 2.53 percent, 2.26 percent, 1.64 percent and 1.23 percent, respectively. All other prices increased by less than one percent.

When the electricity and hydropower price was increased by 20 percent, almost all processing sectors showed price increases of less than one percent. Exceptional sectors were water supply and sanitary services (sector 66) and state and local government enterprises (sector 77) where prices increased by 3.44 percent and 2.19 percent, respectively. Processing sectors with price increases more than one percent were stone and clay mining and quarrying (sector 7); nonferrous metal ores mining (sector 6); iron and ferroalloy ores mining (sector 5); natural gas production (sector 79); and petroleum products production (sector 78).

When all energy prices were increased by 20 percent, simultaneously, almost all processing sectors in Rest of U.S. showed price increases of more than one percent. Sectors that were most affected are water supply and sanitary services (sector 66); paving and roofing material (sector 29); stone and clay mining and quarrying (sector 7); and state and local government enterprises (sector 77). Prices of these sectors increased by 11.14 percent, 10.52 percent, 7.09 percent, and 5.57 percent, respectively. Industries dealing with metal ores mining also showed large increases in prices. Prices of nonferrous ores mining (sector 7), nonferrous metal ores mining (sector 6), iron and ferroalloy ores mining (sector 5) and primary iron and steel manufacturing (sector 35) in Rest of U.S. increased by 7.09 percent, 3.97 percent, 3.51 percent and 3.23 percent, respectively, in response to a 20 percent increase in all energy prices.

Prices of forestry and fishery products (sector 3) and agricultural, forestry, and fishery services (sector 4) in Rest of U.S. increased by 4.36 percent and 3.07 percent, respectively, if all energy prices were increased by 20 percent. Prices of livestock and livestock products (sector 1) and crops and other agricultural products (sector 2) increased by 1.79 percent and 1.51 percent, respectively.

Impacts of Actual Petroleum Product Price Changes Between 1977-1981

The truncated interregional input-output price model was applied using actual price changes that occurred in petroleum product prices in Oklahoma and Rest of U.S. between 1977 and 1981. Crude oil prices in Oklahoma increased from $9.98 per barrel in 1977 to $38.14 per barrel in 1981, or a 282 percent increase (128). For the same period, crude oil prices in Rest of U.S. increased from $8.57 per barrel in 1977 to $31.77 per barrel in 1981, or 270 percent increase (128). In order to obtain the real impacts of petroleum product price increases on other commodity prices, the general price level increases on petroleum product prices were eliminated. The producer's price indexes of all commodities from the U.S. Department of Commerce (121) were used to deflate the 1981 petroleum product prices in both Okalhoma and the Rest of U.S. to 1977 dollars. The producer's price indexes (1967=100) increased from 194.2 in 1977 to 293.4 in 1981 (121). Hence, the crude oil prices in Oklahoma in constant 1977 dollars increased from $9.98 per barrel in 1977 to $19.52 per barrel in 1981, or 153 percent increase. For the same period, crude oil prices in Rest of U.S. increased from $8.57 per barrel in 1977 to $16.28 per barrel in constant 1977 prices in 1981, or 145 percent increase.

Estimated impacts of actual price changes that occurred in petroleum product prices in Oklahoma and Rest of U.S. between 1977 and 1981 on other commodity prices are presented in Table XXXVIII. In Oklahoma, price changes varied widely among sectors from 1.02 percent increase for real estate and rental (sector 69) to 43.16 percent for transportation and warehousing (sector 63). Nine processing sectors in Oklahoma showed impacts of price increases of more than ten percent. Price increases were highest in the following ten sectors: 43.16 percent for transportation and warehousing (sector 63); 20.94 percent for paper and allied products, except containers (sector 22); 17.34 percent for agricultural, forestry, and fishery services (sector 4); 16.39 percent for forestry and fishery products (sector 3); 16.21 percent for crops and other agricultural products (sector 2); 16.13 percent for chemical and selected chemical products (sector 25); 14.55 percent for nonferrous metal ores mining (sector 6); 14.41 percent for

TABLE XXXVIII

REGIONAL REAL COMMODITY PRICE CHANGES RESULTING FROM PETROLEUM PRODUCTS PRICE INCREASES OF 153 PERCENT IN OKLAHOMA AND 145 PERCENT IN REST OF U.S. BETWEEN 1977 AND 1981 (1977 DOLLARS)

	Input-Output Sector	Oklahoma	Rest of U.S.
1.	Livestock and livestock products	1.1036	1.0911
2.	Crops and other agricultural products	1.1621	1.0883
3.	Forestry and fishery products	1.1639	1.3000
4.	Agricultural, forestry and fishery services	1.1734	1.1837
5.	Iron and ferroalloy ores mining	--	1.1086
6.	Nonferrous metal ores mining	1.1455	1.1436
7.	Stone and clay mining and quarrying	1.0712	1.3429
8.	Chemical and fertilizer mineral mining	1.1441	1.0716
9.	New construction	1.0714	1.0724
10.	Maintenance and repair construction	1.0745	1.1405
11.	Ordnance and accessories	1.0593	1.0406
12.	Food and kindred products	1.0680	1.0693
13.	Tobacco manufacturers	--	1.0636
14.	Broad and narrow fabrics, yarn and thread mills	1.0486	1.0431
15.	Miscellaneous textile goods and floor coverings	1.0408	1.0469
16.	Apparel	1.0369	1.0459
17.	Miscellaneous fabricated textile products	1.0312	1.0325
18.	Lumber and wood products, except containers	1.0694	1.1065
19.	Wood containers	1.0713	1.0647
20.	Household furniture	1.0441	1.0523
21.	Other furniture and fixtures	1.0384	1.0447
22.	Paper and allied products, except containers	1.2094	1.0934
23.	Paperboard containers and boxes	1.0875	1.0841
24.	Printing and publishing	1.0417	1.0453
25.	Chemicals and selected chemical products	1.1613	1.0685
26.	Plastics and synthetic materials	1.0813	1.0737
27.	Drugs, cleaning and toilet preparations	1.0645	1.0617
28.	Paints and allied products	1.0613	1.0931
29.	Paving and roofing material	1.0763	1.5438
30.	Rubber and miscellaneous plastic products	1.0436	1.0393
31.	Leather tanning and finishing	1.0960	1.0650
32.	Footwear and other leather products	1.0414	1.0388
33.	Glass and glass products	1.0645	1.0619
34.	Stone and clay products	1.0891	1.1119
35.	Primary iron and steel manufacturing	1.0755	1.0765
36.	Primary nonferrous metal manufacturing	1.0584	1.0744
37.	Metal containers	1.0636	1.0559

TABLE XXXVIII Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.
38.	Heating, plumbing and structural metal products	1.0384	1.0443
39.	Screw machine products and stamping	1.0904	1.0409
40.	Other fabricated metal products	1.0367	1.0392
41.	Engines and turbines	1.0412	1.0404
42.	Farm and garden machinery	1.0443	1.0488
43.	Construction and mining machinery	1.0325	1.0502
44.	Materials handling machinery and equipment	1.0350	1.0396
45.	Metal working machinery and equipment	1.0399	1.0489
46.	Special industry machinery and equipment	1.0321	1.0602
47.	General industrial machinery and equipment	1.0305	1.0932
48.	Miscellaneous machinery, except electrical	1.0326	1.0707
49.	Office, computing and accounting machines	1.0333	1.0389
50.	Service industry machines	1.0341	1.0449
51.	Electric industrial equipment and apparatus	1.0333	1.0540
52.	Household appliances	1.0690	1.0391
53.	Electric lighting and wiring equipment	1.0415	1.0319
54.	Radio, TV and communication equipment	1.0205	1.0268
55.	Electronic components and accessories	1.0305	1.0330
56.	Miscellaneous electrical machinery and supplies	1.0652	1.0346
57.	Motor vehicles and equipment	1.0311	1.0289
58.	Aircraft and parts	1.0265	1.0397
59.	Other transportation equipment	1.0599	1.0718
60.	Scientific and controlling instruments	1.0255	1.0594
61.	Optical, ophthalmic, and photo equipment	1.0278	1.0358
62.	Miscellaneous manufacturing	1.0408	1.0590
63.	Transportation and warehousing	1.4316	1.1745
64.	Communications, except radio and TV	1.0093	1.0191
65.	Radio and TV broadcasting	1.0163	1.0358
66.	Water supply and sanitary services	1.0092	1.3182
67.	Wholesale and retail trade	1.0127	1.0480
68.	Finance and insurance	1.0137	1.0380
69.	Real estate and rental	1.0102	1.0332
70.	Hotels; personal and repair services except auto	1.0181	1.0785
71.	Business services	1.0282	1.0647
72.	Eating and drinking places	1.0456	1.0513
73.	Automobile repair and services	1.0259	1.0602
74.	Amusements	1.0234	1.0422
75.	Medical educational services and nonprofit organization	1.0173	1.0522
76.	Federal government enterprises	1.0594	1.0603
77.	State and local government enterprises	1.0349	1.1654
78.	Petroleum products production	2.5291	2.4539

TABLE XXXVIII (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.
79.	Natural gas production	1.0550	1.2700
80.	Coal mining	1.0526	1.0731
81.	Electricity and hydropower	1.0332	1.2923

chemical and fertilizer mineral mining (sector 8); 10.36 percent for livestock and livestock products (sector 1); and 9.6 percent for leather tanning and finishing (sector 31).

Prices of other energy processing sectors in Oklahoma did not respond much to petroleum product price changes. Prices of natural gas production (sector 79), coal mining (sector 80), and electricity and hydropower (sector 81), increased 5.50 percent, 5.26 percent, and 3.32 percent, respectively, as a result of changes in petroleum product prices.

Impacts of petroleum product prices on the Rest of U.S. commodity prices varied from 1.91 percent increase in communication except radio and TV (sector 64) to 54.38 percent increase in paving and roofing materials (sector 29). Price increases were highest in the following ten sectors of Rest of U.S.: 54.38 percent for paving and roofing materials (sector 29); 34.29 percent for stone and clay mining and quarrying (sector 7); 31.82 percent for water supply and sanitary services (sector 66); 30.0 percent for forestry and fishery products (sector 3); 29.23 percent for electricity and hydropower (sector 81); 27.0 percent for natural gas production (sector 79); 18.37 percent for agricultural, forestry, and fishery services (sector 4); 17.45 percent for transportation and warehousing (sector 63); 16.54 percent for state and local government enterprises (sector 77); and 14.36 percent for nonferrous metal ores mining (sector 6). Prices of livestock and livestock products (sector 1) and crops and other agricultural products (sector 2) increased about 9.11 percent and 8.83 percent, respectively.

Impacts of Natural Gas Price Changes
Between 1977-1981

Natural gas price increased from 79 cents per thousand cubic feet at wellhead in Oklahoma in 1977 to 185.4 cents in 1981 or about 135 percent increase (128). Natural gas prices in Rest of U.S. increased from 79 cents in 1977 to $1.98 in 1981, or a 151 percent increase (128). The natural gas prices in constant 1977 dollars in Oklahoma increased from 79 cents per thousand cubic feet to 123 cents in 1981, or 55 percent increase. At the same time, natural gas prices in constant dollars in the Rest of U.S. increased from 79.0 to 140 cents, or about 66 percent. Estimated impacts of real natural gas price increases on commodity prices in Oklahoma and Rest of U.S. in 1981 based on 1977 prices are presented in Table XXXIX.

In Oklahoma, impacts of the natural gas price increases were to raise commodity prices in various sectors from 0.20 percent for real estate and rental (sector 69) to 17.28 percent in electricity and hydropower (sector 81). Price increases in the ten most impacted sectors are 17.28 percent for electricity and hydropower (sector 81); 4.30 percent for chemical and selected chemical products (sector 25); 4.12 percent for paper and allied products, except containers (sector 22); 3.91 percent for metal containers (sector 37); 3.21 percent for primary nonferrous metal manufacturing (sector 36); 3.16 percent for agricultural, forestry, and fishery services (sector 4); 3.08 percent for nonferrous metal ores mining (sector 6); 3.02 percent for state and local government enterprises (sector 77); 3.01 percent for screw machine products and stamping (sector 39); and 2.95 percent for stone and clay products (sector 34). Prices of livstock and livestock products (sector

TABLE XXXIX

REGIONAL REAL COMMODITY PRICE CHANGES RESULTING FROM NATURAL GAS PRICE INCREASE OF 55 PERCENT IN OKLAHOMA AND 66 PERCENT IN REST OF U.S. BETWEEN 1977 AND 1981 (1977 DOLLARS)

	Input-Output Sector	Oklahoma	Rest of U.S.
1.	Livestock and livestock products	1.0134	1.0200
2.	Crops and other agricultural products	1.0101	1.0151
3.	Forestry and fishery products	1.0217	1.0369
4.	Agricultural, forestry and fishery services	1.0316	1.0271
5.	Iron and ferroalloy ores mining	--	1.0478
6.	Nonferrous metal ores mining	1.0308	1.0546
7.	Stone and clay mining and quarrying	1.0101	1.0830
8.	Chemical and fertilizer mineral mining	1.0105	1.0315
9.	New construction	1.0144	1.0154
10.	Maintenance and repair construction	1.0093	1.0218
11.	Ordnance and accessories	1.0256	1.0146
12.	Food and kindred products	1.0137	1.0179
13.	Tobacco manufacturers	--	1.0143
14.	Broad and narrow fabrics, yarn and thread mills	1.0135	1.0157
15.	Miscellaneous textile goods and floor coverings	1.0150	1.0175
16.	Apparel	1.0109	1.0148
17.	Miscellaneous fabricated textile products	1.0082	1.0110
18.	Lumber and wood products, except containers	1.0139	1.0193
19.	Wood containers	1.0108	1.0138
20.	Household furniture	1.0099	1.0140
21.	Other furniture and fixtures	1.0102	1.0138
22.	Paper and allied products, except containers	1.0412	1.0283
23.	Paperboard containers and boxes	1.0243	1.0230
24.	Printing and publishing	1.0111	1.0135
25.	Chemicals and selected chemical products	1.0430	1.0284
26.	Plastics and synthetic materials	1.0213	1.0263
27.	Drugs, cleaning and toilet preparations	1.0111	1.0157
28.	Paints and allied products	1.0177	1.0234
29.	Paving and roofing material	1.0195	1.1685
30.	Rubber and miscellaneous plastic products	1.0136	1.0108
31.	Leather tanning and finishing	1.0193	1.0170
32.	Footwear and other leather products	1.0126	1.0114
33.	Glass and glass products	1.0271	1.0292
34.	Stone and clay products	1.0295	1.0354
35.	Primary iron and steel manufacturing	1.0262	1.0328
36.	Primary nonferrous metal manufacturing	1.0321	1.0317
37.	Metal containers	1.0391	1.0217

TABLE XXXIX (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.
38.	Heating, plumbing and structural metal products	1.0122	1.0162
39.	Screw machine products and stamping	1.0301	1.0158
40.	Other fabricated metal products	1.0112	1.0146
41.	Engines and turbines	1.0168	1.0149
42.	Farm and garden machinery	1.0130	1.0161
43.	Construction and mining machinery	1.0125	1.0354
44.	Materials handling machinery and equipment	1.0210	1.0146
45.	Metal working machinery and equipment	1.0256	1.0142
46.	Special industry machinery and equipment	1.0118	1.0174
47.	General industrial machinery and equipment	1.0109	1.0278
48.	Miscellaneous machinery except electrical	1.0102	1.0185
49.	Office, computing and accounting machines	1.0093	1.0128
50.	Service industry machines	1.0272	1.0143
51.	Electric industrial equipment and apparatus	1.0111	1.0176
52.	Household appliances	1.0126	1.0145
53.	Electric lighting and wiring equipment	1.0205	1.0122
54.	Radio, TV and communication equipment	1.0063	1.0095
55.	Electronic components and accessories	1.0138	1.0121
56.	Miscellaneous electrical machinery and supplies	1.0203	1.0150
57.	Motor vehicles and equipment	1.0147	1.0101
58.	Aircrafts and parts	1.0081	1.0123
59.	Other transportation equipment	1.0186	1.0219
60.	Scientific and controlling instruments	1.0091	1.0168
61.	Optical, ophthalmic and photo equipment	1.0107	1.0111
62.	Miscellaneous manufacturing	1.0110	1.0160
63.	Transportation and warehousing	1.0162	1.0262
64.	Communications, except radio and TV	1.0031	1.0076
65.	Radio and TV broadcasting	1.0083	1.0146
66.	Water supply and sanitary services	1.0053	1.1493
67.	Wholesale and retail trade	1.0050	1.0139
68.	Finance and insurance	1.0042	1.0131
69.	Real estate and rental	1.0020	1.0080
70.	Hotels; personal and repair services except auto	1.0068	1.0230
71.	Business services	1.0101	1.1044
72.	Eating and drinking places	1.0128	1.0188
73.	Automobile repair and services	1.0259	1.0140
74.	Amusements	1.0099	1.0138
75.	Medical educational services and nonprofit organization	1.0080	1.0187
76.	Federal government enterprises	1.0265	1.0202
77.	State and local government enterprises	1.0302	1.0750
78.	Petroleum products production	1.0161	1.1592

TABLE XXXIX (Continued)

	Input-Output Sector	Oklahoma	Rest of U.S.
79.	Natural gas production	1.5534	1.6590
80.	Coal mining	1.0112	1.0209
81.	Electricity and hydropower	1.1728	1.1425

1) and crops and other agricultural products (sector 2) increased by 1.34 percent and 1.01 percent in response to the increase in natural gas prices between 1977 and 1981. Prices of petroleum products (sector 78) and coal mining (sector 80) increased 1.61 percent and 1.12 percent, respectively.

Impacts of natural gas price increases on Rest of U.S. commodity prices ranged from 0.76 percent for communications, except radio and TV (sector 64) to 16.85 percent for paving and roofing material (sector 29). Impacts of natural gas price increases were large on the following processing sectors: 16.85 percent for paving and roofing material (sector 29); 15.92 percent for petroleum products production (sector 78); 14.93 percent for water supply and sanitary services (sector 66); 14.25 percent for electricity and hydropower (sector 81); 8.30 percent for stone and clay mining and quarrying (sector 7); 7.50 percent for state and local government enterprises (sector 77); 5.46 percent for nonferrous metal ores mining (sector 6); 4.78 percent for iron and ferroalloy ores mining (sector 5); 3.69 percent for forestry and fishery products (sector 3); and 3.54 percent for both stone and clay products (sector 36) and construction and mining machinery (sector 43).

Impact of natural gas price increases on coal prices in Rest of U.S. was 2.09 percent increase. Livestock and livestock products (sector 1) prices increased by 2.0 percent and crops and other agricultural products (sector 2) prices increased by 1.51 percent in response to changes in natural gas prices from 1977 through 1981.

CHAPTER IX

EMPIRICAL RESULTS OF A MODIFIED INTERREGIONAL INPUT-OUTPUT PRICE MODEL

Introduction

Changes in commodity prices have differential impacts on input-output coefficients and multipliers of an interregional model. A modified interregional input-output price model developed to measure these impacts was explained in Chapter III. This chapter presents estimates of impacts of commodity price changes resulting from actual real energy price increases that occurred in Oklahoma and the Rest of U.S. during 1977-81 on interregional input-output coefficients and multipliers. Effects of energy price increases on commodity prices were estimated by a truncated interregional input-output price model and presented in Tables XXXVIII and XXXIX of Chapter VIII. These price vectors were used to construct P^* and P^{*-1} matrices for a modified interegional input-output price model. Then a new interregional input-output coefficient matrix $[P^*BP^{*-1}]$ and a new direct and indirect matrix $[I-P^*BP^{*-1}]^{-1}$ were derived. The new input-output coefficient matrix $[P^*BP^{*-1}]$ includes the impacts of energy price increases in the technical coefficients and value added coefficients.

The new direct and indirect coefficients matrix $[I-P^{*}BP^{*-1}]^{-1}$ gives new output multipliers for each processing sector as a result of energy price increases. However, income and employment multipliers of the interregional model will not change if the income-output coefficients and employment-output coefficients are deflated by the new prices. Therefore, the present study estimates final impacts of energy price increases through changes in value added coefficients and value added and output multipliers.

Value Added Impact in the Modified Interregional Input-Output Model

Value added multipliers are used instead of income multipliers in measuring the final impacts of energy price increases on regional income. While income is measured as wage and salary payments and proprietors' income, value added is measured as the difference between the value of the industry's total output and the cost of the goods and services it purchases from other industries. Value added represents the sum of total factor payments and capital consumption allowance. It is total income generated within the region but part of it may flow out of the region as income payments to non-residents as factor payment.

Value added multipliers measure the total change in value added throughout the economy resulting from a one dollar change in value added in a given sector in response to a final demand change. The Type I value added multiplier is expressed as the ratio of direct and indirect value added change to direct value added change. The direct value added change for each industrial sector is given by the value added coefficient of that sector. The direct and indirect value added change of a sector is derived by multiplying each column entry of that sector in the inverse matrix $[I-B]^{-1}$ of the interregional model by the corresponding value added coefficient and summing. Type II value added mutliplier is computed by dividing the direct, indirect and induced value added change by direct value added change. The direct, indirect, and induced value added change of a sector is derived by multiplying each column entry of that sector in the inverse matrix $[I-B_H]^{-1}$ by the corresponding value added coefficient and summing.

Estimates of value added coefficients and value added multipliers in Oklahoma for the base year 1977 are presented in Table XL. Value added coefficients in Oklahoma in 1977 ranged from 0.13892 for livestock and livestock products (sector 1) to 0.85927 for water supply and sanitary services (sector 66). Value added coefficients were high in the following processing sectors, i.e.; 0.85927 for water supply and sanitary services (sector 66); 0.83631 for petroleum products production (sector 78); 0.81147 for paving and roofing material (sector 29); 0.79306 for natural gas production (sector 79); 0.78359 for comunications, except radio (sector 64); 0.77123 for real estate and rental (sector 69); 0.76560 for wholesale and retail trade (sector 69).

The Type I value added multipliers of Oklahoma in 1977 ranged from 1.16378 for water supply and sanitary services (sector 66) to 7.19831 for livestock and livestock products (sector 1). Type I value added multipliers were high in the following sectors, i.e.; 7.19831 for livestock and livestock products (sector 1); 3.87456 for other transportation equipment (sector 59); 3.70224 for food and kindred products (sector 12); 3.69557 for paper and allied products, except

TABLE XL

VALUE ADDED COEFFICIENTS AND VALUE ADDED MULTILIERS, OKLAHOMA, 1977

Input-Output Sector	Value Added Coefficients	Value Added Multipliers Type I	Value Added Multipliers Type II
1. Livestock and livestock products	0.13892	7.19831	32.60357
2. Crops and other agricultural products	0.56237	1.77820	2.20207
3. Forestry and fishery products	0.54472	1.83581	2.34396
4. Agricultural, forestry and fishery services	0.34464	2.90157	17.32520
5. Iron and ferroalloy ores mining	--	--	--
6. Nonferrous metal ores mining	0.50850	1.96657	3.00264
7. Stone and clay mining and quarrying	0.61690	1.62102	2.05472
8. Chemical and fertilizer mineral mining	0.68924	1.45087	1.45196
9. New construction	0.44378	2.25339	34.04209
10. Maintenance and repair construction	0.55032	1.81713	3.37407
11. Ordnance and accessories	0.49924	2.00303	2.06981
12. Food and kindred products	0.27011	3.70224	6.85526
13. Tobacco manufacturers	--	--	--
14. Broad and narrow fabrics, yarn and thread mills	0.47099	2.12319	2.65714
15. Miscellaneous textile goods and floor coverings	0.41848	2.38960	3.99860
16. Apparel	0.33249	3.00764	18.18287
17. Miscellaneous fabricated textile products	0.49662	2.01361	3.65635
18. Lumber and wood products, except containers	0.48239	2.07299	3.25430

TABLE XL (Continued)

Input-Output Sector	Value Added Coefficients	Multipliers Type I	Multipliers Type II
19. Wood containers	0.63360	1.57829	5.12393
20. Household furniture	0.46246	2.16236	7.09185
21. Other furniture and fixtures	0.56733	1.76266	5.25681
22. Paper and allied products, except containers	0.27059	3.69557	6.17012
23. Paperboard containers and boxes	0.30999	3.22587	33.66973
24. Printing and publishing	0.46528	2.14924	6.97719
25. Chemicals and selected chemical products	0.45148	2.21496	3.01992
26. Plastics and synthetic materials	0.34842	2.87012	4.88587
27. Drugs, cleaning and toilet preparations	0.40845	2.44826	15.20811
28. Paints and allied products	0.32452	3.08149	29.99556
29. Paving and roofing material	0.81147	1.23233	1.44025
30. Rubber and miscellaneous plastic products	0.54086	1.84890	2.82664
31. Leather tanning and finishing	0.31686	3.15598	3.17267
32. Footwear and other leather products	0.45779	2.18439	7.24436
33. Glass and glass products	0.53308	1.87589	7.18406
34. Stone and clay products	0.44120	2.26653	5.52144
35. Primary iron and steel manufacturing	0.40937	2.44279	7.52923
36. Primary nonferrous metal manufacturing	0.32357	3.09057	18.85908
37. Metal containers	0.31976	3.12736	4.77769
38. Heating, plumbing and structural metal products	0.52686	1.89803	4.67862
39. Screw machine products and stamping	0.47388	2.11023	11.38233
40. Other fabricated metal products	0.61290	1.63158	2.56994
41. Engines and turbines	0.49726	2.01101	2.06429

TABLE XL (Continued)

Input-Output Sector	Coefficients	Value Added Multipliers Type I	Type II
42. Farm and garden machinery	0.44213	2.26179	4.90267
43. Construction and mining machinery	0.52141	1.91788	4.64725
44. Materials handling machinery and equipment	0.51382	1.94620	2.89912
45. Metal working machinery and equipment	0.60226	1.66040	3.51807
46. Special industry machinery and equipment	0.50802	1.96844	2.86397
47. General industrial machinery and equipment	0.58079	1.72180	4.21023
48. Miscellaneous machinery except electrical	0.59323	1.68568	3.94917
49. Office, computing and accounting machines	0.32945	3.03537	3.34281
50. Service industry machines	0.50200	1.99202	4.62909
51. Electric industrial equipment and apparatus	0.50433	1.98282	4.95768
52. Household appliances	0.45522	2.19673	8.70767
53. Electric lighting and wiring equipment	0.55665	1.79648	1.85895
54. Radio, TV and communication equipment	0.56601	1.76674	2.96344
55. Electronic components and accessories	0.56776	1.76130	2.00116
56. Miscellaneous electrical machinery and supplies	0.53854	1.85688	2.42238
57. Motor vehicles and equipment	0.51700	1.93423	3.75187
58. Aircrafts and parts	0.52230	1.91462	9.12323
59. Other transportation equipment	0.25809	3.87456	5.67163
60. Scientific and controlling instruments	0.64647	1.54686	2.64321
61. Optical, ophthalmic, and photo equipment	0.61337	1.63033	2.04273

TABLE XL (Continued)

Input-Output Sector	Coefficients	Value Added Multipliers Type I	Type II
62. Miscellaneous manufacturing	0.48276	2.07141	4.70801
63. Transportation and warehousing	0.37920	2.63714	7.16959
64. Communications, except radio and TV	0.78359	1.27617	3.58919
65. Radio and TV broadcasting	0.47341	2.11235	13.03149
66. Water supply and sanitary services	0.85927	1.16378	1.70938
67. Wholesale and retail trade	0.76560	1.30616	8.08860
68. Finance and insurance	0.51314	1.94879	13.88545
69. Real estate and rental	0.77123	1.29663	1.38250
70. Hotels; personal and repair service except auto	0.57034	1.75334	4.10213
71. Business services	0.52188	1.91614	3.89230
72. Eating and drinking places	0.34265	2.91847	4.87490
73. Automobile repair and services	0.41944	2.38415	4.31410
74. Amusements	0.48510	2.06144	9.07684
75. Health, educational and social services and nonprofit organizations	0.63950	1.56372	3.72801
76. Federal government enterprise	0.66791	1.49722	3.99646
77. State and local government enterprise	0.52570	1.90222	3.31805
78. Petroleum products production	0.83631	1.19573	1.54960
79. Natural gas production	0.79306	1.26093	4.40774
80. Coal mining	0.71634	1.39599	2.21082
81. Electricity and hydropower	0.46389	2.15569	2.89143

containers (sector 22); 3.22587 for paperboard containers and boxes (sector 23); 3.15598 for leather tanning and finishing (sector 31); 3.12736 for metal containers (sector 37); 3.09057 for primary nonferrous metal manufacturing (sector 36); 3.00764 for apparel (sector 16); and 3.03537 for office, computing and accounting machines (sector 49).

Type II value added multipliers for Oklahoma in 1977 ranged from 1.38250 for real estate and rental (sector 69) to 34.04209 for new construction (sector 9). Type II value added multipliers were high in the following sectors, i.e.; 34.04209 for new construction (sector 9); 33.66973 for paperboard containers and boxes (sector 23); 32.60357 for livestock and livestock products (sector 1); 29.99556 for paints and allied products (sector 28); 18.85908 for primary nonferrous metal manufacturing (sector 36); 18.18287 for apparel (sector 16); 17.32520 for agricultural, forestry and fishery services (sector 4); and 15.20811 for drugs, cleaning and toilet preparations (sector 27).

Effects of Energy Price Changes on Value Added Interregional Multipliers

Impacts of Petroleum Product Price Changes Between 1977 and 1981

The impacts of actual real petroleum price increases of 153 percent in Oklahoma and 145 percent in the Rest of U.S. between 1977-1981 on regional commodity prices were estimated and presented in Table XXXVI of Chapter VIII. These prices were used to construct P^* and P^{*-1} vectors and $[P^*BP^{*-1}]$ and $[I-P^*BP^{*-1}]^{-1}$ matrices. New value added coefficients were estimated from the $[P^*BP^{*-1}]$ matrix by subtracting the sum of the column entry of a given sector from one. New value added and output multipliers were derived through the manipulation of the $[I-P^*BP^{*-1}]^{-1}$ matrix. An inverse matrix $[I-P^*BP^{*-1}]^{-1}$ allows only the computation of Type I value added multipliers. The computation of Type II multipliers requires the inclusion of household as an endogenous sector of the model. Hence, the impacts of petroleum product price increases on other commodity prices were estimated once again with households as an endogenous sector of a truncated interregional input-output price model. Then new price vectors, P* and P^{*-1}, were derived and a new inverse matrix $[I-P^*B_HP^{*-1}]^{-1}$ with the endogenous household sector was used to compute Type II value added multipliers.

Estimated impacts of petroleum price increases between 1977-1981 on value added coefficients and value added multipliers are presented in Table XLI. The 1981 value added coefficients of Oklahoma ranged from 0.12528 for livestock and livestock products (sector 1) to 0.92072 for petroleum products production (sector 78) when impacts of petroleum product price increases were included in the model. The 1981 value added coefficients were high in the following sectors; 0.92072 for petroleum products production (sector 78); 0.85144 for water supply and sanitary services (sector 66); 0.77635 for communications, except radio and TV (sector 64); 0.76344 for real estate and rental (sector 69); 0.75602 for wholesale and retail trade (sector 67); 0.75395 for paving and roofing material (sector 29); 0.75171 for natural gas production (sector 79); 0.68053 for coal mining (sector 80); 0.63045 for federal government enterprises (sector 76); and 0.63038 for scientific and controlling instruments (sector 60).

TABLE XLI

IMPACTS OF PETROLEUM PRODUCT PRICE INCREASES OF 153 PERCENT IN OKLAHOMA AND 145 PERCENT IN REST OF U.S. BETWEEN 1977-1981 ON VALUE ADDED COEFFICIENTS AND VALUE ADDED MULTIPLIERS, OKLAHOMA, 1981 (1977 DOLLARS)

Input-Output Sector	1981 Value Added Coefficients	1981 Value Added Multipliers Type I	1981 Value Added Multipliers Type II	1977-81 Percent Change Coefficients	1977-81 Percent Change Multipliers Type I	1977-81 Percent Change Multipliers Type II
1. Livestock and livestock products	0.12588	7.94409	40.08061	-9.38	10.36	12.52
2. Crops and other agricultural products	0.48394	2.06637	2.69878	-13.95	16.21	22.56
3. Forestry and fishery products	0.46801	2.13672	2.92769	-14.08	16.39	24.90
4. Agricultural, forestry and fishery services	0.29372	3.40464	23.50320	-14.77	17.34	35.66
5. Iron and ferroalloy ores mining	--	--	--	--	--	--
6. Nonferrous metal ores mining	0.44390	2.25276	3.74511	-12.70	14.55	24.73
7. Stone and clay mining and quarrying	0.57591	1.73640	2.36379	-6.64	7.12	15.04
8. Chemical and fertilizer mineral mining	0.60243	1.65994	1.69855	-12.60	14.41	16.98
9. New construction	0.41421	2.41424	42.84897	-6.66	7.14	25.87
10. Maintenance and repair construction	0.51217	1.95246	4.05769	-6.93	7.45	20.26
11. Ordnance and accessories	0.47132	2.12172	2.34816	-5.59	5.93	13.45
12. Food and kindred products	0.25292	3.95383	8.18868	-6.36	6.80	19.45
13. Tobacco manufacturers	--	--	--	--	--	--
14. Broad and narrow fabrics, yarn and thread mills	0.44920	2.22617	3.02714	-4.63	4.85	13.92
15. Miscellaneous textile goods and floor coverings	0.40206	2.48721	4.64668	-3.92	4.08	16.21
16. Apparel	0.32067	3.11846	22.10679	-3.55	3.68	20.91
17. Miscellaneous fabricated textile products	0.48160	2.07642	4.23663	-3.02	3.12	15.87
18. Lumber and wood products, except containers	0.45107	2.21693	3.84129	-6.49	-6.94	18.04

TABLE XLI (Continued)

Input-Output Sector	1981 Value Added Coefficients	1981 Value Added Multipliers Type I	1981 Value Added Multipliers Type II	1977-81 Percent Change Coefficients	1977-81 Percent Change Multipliers Type I	1977-81 Percent Change Multipliers Type II
19. Wood containers	0.59143	1.69081	6.33011	-6.66	7.13	23.54
20. Household furniture	0.44294	2.25764	8.52985	-4.22	4.41	20.28
21. Other furniture and fixtures	0.54634	1.83036	6.30253	-3.70	3.84	19.89
22. Paper and allied products, except containers	0.22375	4.46935	8.15907	-17.31	20.94	32.24
23. Paperboard containers and boxes	0.28505	3.50810	42.22968	-8.05	8.75	25.42
24. Printing and publishing	0.44665	2.23889	8.37498	-4.00	4.17	20.03
25. Chemicals and selected chemical products	0.38877	2.57221	3.76940	-13.89	16.13	24.82
26. Plastics and synthetic materials	0.32223	3.10338	5.80862	-7.52	8.13	18.89
27. Drugs, cleaning and toilet preparations	0.38372	2.60607	18.73602	-6.05	6.45	23.20
28. Paints and allied products	0.30579	3.27024	36.49927	-5.77	6.13	21.68
29. Paving and roofing material	0.75395	1.32635	1.62304	-7.09	7.63	12.69
30. Rubber and miscellaneous plastic products	0.51826	1.92952	3.25390	-4.18	4.36	15.12
31. Leather tanning and finishing	0.28911	3.45888	3.74596	-8.76	9.60	18.07
32. Footwear and other leather products	0.43960	2.27482	8.69435	-3.97	4.14	20.02
33. Glass and glass products	0.50070	1.99691	8.84482	-6.07	6.45	23.12
34. Stone and clay products	0.40510	2.46855	6.77273	-8.18	8.91	22.66
35. Primary iron and steel manufacturing	0.38063	2.62722	9.27742	-7.02	7.55	23.22
36. Primary nonferrous metal manufacturing	0.30570	3.27113	23.37023	-5.52	5.84	23.92
37. Metal containers	0.30064	3.32622	5.71554	-5.97	6.36	19.63
38. Heating, plumbing and structural metal products	0.50739	1.97087	5.57895	-3.70	3.84	19.24
39. Screw machine products and stamping	0.43459	2.30103	14.39398	-8.29	9.04	26.46
40. Other fabricated metal products	0.59121	1.69143	2.96029	-3.54	3.67	15.19
41. Engines and turbines	0.47758	2.09391	2.31425	-3.96	4.12	12.11
42. Farm and garden machinery	0.42337	2.36200	5.84380	-4.24	4.43	19.20

TABLE XLI (Continued)

Input-Output Sector	1981 Value Added Coefficients	Multipliers Type I	Multipliers Type II	1977-81 Percent Change Coefficients	Multipliers Type I	Multipliers Type II
43. Construction and mining machinery	0.50500	1.98201	5.51545	-3.15	3.25	18.68
44. Materials handling machinery and equipment	0.49645	2.01430	3.33934	-3.38	3.50	15.18
45. Metal working machinery and equipment	0.57916	1.72664	4.16319	-3.84	3.99	18.34
46. Special industry machinery and equipment	0.49233	2.03159	3.29153	-3.11	3.21	14.93
47. General industrial machinery and equipment	0.56360	1.77431	4.99952	-2.96	3.05	18.75
48. Miscellaneous machinery except electrical	0.57452	1.74060	4.67860	-3.54	3.26	18.47
49. Office, computing and accounting machines	0.31884	3.13639	3.80176	-3.22	3.33	13.73
50. Service industry machines	0.48543	2.06003	5.48987	-3.30	3.41	18.60
51. Electric industrial equipment and apparatus	0.48807	2.04888	5.88605	-3.22	3.33	18.73
52. Household appliances	0.42585	2.34823	10.75409	-6.45	6.90	23.50
53. Electric lighting and wiring equipment	0.53448	1.87099	2.05951	-3.98	4.15	10.79
54. Radio, TV and communication equipment	0.55467	1.80289	3.38273	-2.00	2.05	14.15
55. Electronic components and accessories	0.55094	1.81507	2.21547	-2.96	-3.05	10.71
56. Miscellaneous electrical machinery and supplies	0.50557	1.97796	2.81284	-6.12	6.52	16.12
57. Motor vehicles and equipment	0.50139	1.99444	4.36253	-3.02	3.11	16.28
58. Aircrafts and parts	0.50883	1.96530	11.08179	-2.58	2.65	21.47
59. Other transportation equipment	0.24351	4.10667	7.31000	-5.53	5.99	28.89
60. Scientific and controlling instruments	0.63038	1.58635	3.03233	-2.49	2.55	14.72
61. Optical, ophthalmic, and photo equipment	0.59679	1.67562	2.27449	-2.70	2.78	11.35

TABLE XLI (Continued)

	Input-Output Sector	1981 Value Added Coefficients	1981 Value Added Multipliers Type I	1981 Value Added Multipliers Type II	1977-81 Percent Change Coefficients	1977-81 Percent Change Multipliers Type I	1977-81 Percent Change Multipliers Type II
62.	Miscellaneous manufacturing	0.46386	2.15583	5.58614	-3.91	4.08	18.65
63.	Transportation and warehousing	0.26488	3.77525	11.08545	-30.15	43.16	54.62
64.	Communications, except radio and TV	0.77635	1.28808	4.20580	-0.92	0.93	17.18
65.	Radio and TV broadcasting	0.46584	2.14667	15.56117	-1.60	1.15	19.41
66.	Water supply and sanitary services	0.85144	1.17448	1.87986	-0.91	0.92	9.97
67.	Wholesale and retail trade	0.75602	1.32271	9.80387	-1.25	1.27	21.21
68.	Finance and insurance	0.50619	1.97554	16.73736	-1.35	1.37	20.55
69.	Real estate and rental	0.76344	1.30986	1.44718	-1.01	1.02	4.68
70.	Hotels; personal and repair service except auto	0.56022	1.78501	4.74843	-1.77	1.81	15.76
71.	Business services	0.50759	1.97009	4.50675	-2.74	2.82	15.79
72.	Eating and drinking places	0.32803	3.04850	5.68498	-4.27	4.46	16.62
73.	Automobile repair and services	0.40887	2.44577	4.96244	-2.52	2.58	15.03
74.	Amusements	0.47398	2.10977	10.78895	-2.29	2.34	18.36
75.	Health, educational and social services and nonprofit organizations	0.62860	1.59085	4.50956	-1.70	1.73	20.96
76.	Federal government enterprise	0.63045	1.58616	4.83819	-5.61	5.94	21.06
77.	State and local government enterprise	0.50799	1.96853	3.83001	-3.37	3.49	15.43
78.	Petroleum products production	0.92072	1.08611	1.22116	10.09	-9.17	-20.99
79.	Natural gas production	0.75171	1.33030	5.41060	-5.21	5.50	22.75
80.	Coal mining	0.68053	1.46944	2.55181	-14.19	16.54	15.42
81.	Electricity and hydropower	0.44898	2.22727	3.29961	-3.21	3.32	14.12

The 1981 Type I value added multipliers of Oklahoma ranged from 1.08611 for petroleum product production (sector 78) to 7.94409 for livestock and livestock products (sector 1). Type I value added multipliers were high in the following sectors: 7.94409 for livestock and livestock products (sector 1); 4.46935 for paper and allied products, except containers (sector 22); 4.10667 for other transportation equipment (sector 59); 3.95383 for food and kindred products (sector 12); 3.77525 for transportation and warehousing (sector 63); 3.50810 for paperboard containers and boxes (sector 23); 3.45888 for leather tanning and finishing (sector 31); 3.40464 for agricultural, forestry and fishing services (sector 4); 3.32622 for metal containers (sector 37); and 3.27113 for primary nonferrous metal manufacturing (sector 36).

The 1981 Type II value added multipliers ranged from 1.22116 for petroleum products production (sector 78) to 32.84897 for new construction (sector 9). Type II value added multipliers were high in the following sectors: 42.84897 for new construction (sector 9); 42.22968 for paperboard containers and boxes (sector 23); 40.08061 for livestock and livestock products (sector 1); 36.49927 for paints and allied products (sector 28); 23.50320 for agricultural, forestry, and fishery products (sector 4); 23.37023 for primary nonferrous metal manufacturing (sector 36); 22.10679 for apparel (sector 16); and 18.73602 for drugs, cleaning and toilet preparations (sector 27).

Increases of petroleum product prices between 1977-1981 reduced value added coefficients of all processing sectors of Oklahoma except petroleum products production (sector 78) from their 1977 level. Decreases ranged from 0.91 percent in water supply and sanitary services (sector 66) to 30.15 percent in transportation and warehousing (sector 63). The 1981 value added coefficient of petroleum products production (sector 78) increased about 10.09 percent above its 1977 level. The 1981 value added coefficients showed the greatest reduction in the following sectors: 30.15 percent in transportation and warehousing (sector 63); 17.31 percent in paper and allied products, except containers (sector 22); 14.77 percent in agricultural, forestry and fishery services (sector 4); 14.19 percent in coal mining (sector 80); 14.08 percent in forestry and fishery products (sector 3); 13.95 percent in crops and other agricultural products (sector 2); 13.89 percent in chemicals and selected chemical products (sector 25); 12.70 percent in nonferrous metal ores mining (sector 6); 12.60 percent in chemical and fertilizer mineral mining (sector 8); and 9.38 percent in livestock and livestock products (sector 1).

The petroleum product price increases raised the 1981 Type I value added multipliers of all processing sectors in Oklahoma except petroleum products production (sector 78) above their 1977 level. The increases ranged from 0.92 percent in water supply and sanitary services (sector 66) to 43.16 percent in transportation and warehousing (sector 63). The Type I value added multiplier of petroleum products production (sector 78) decreased about 9.17 percent. Type I value added multipliers showing the greatest increase included the following sectors: 43.16 percent in transportation and warehousing (sector 63); 20.94 percent in paper and allied products, except containers (sector 22); 17.34 percent in agricultural, forestry and fishery services (sector 4); 16.54 percent in coal mining (sector 80); 16.39 percent in forestry and fishery product (sector 3); 16.21 percent in crops and other agricultural product (sector 2); 16.13 percent in chemical and selected chemical products (sector 25); 14.55 percent in nonferrous metal ores mining (sector 6); 14.41 percent in chemical and fertilizer mineral mining (sector 8); and 10.36 percent in livestock and livestock products (sector 1).

The petroleum product price increases raises the Type II value added multipliers of all processing sectors except petroleum products production (sector 78). The increases ranged from 4.68 percent in real estate and rental (sector 69) to 54.62 percent in transportation and warehousing (sector 63). Type II value added multiplier of petroleum products production (sector 78) decreased about 20.99 percent. Type II value added multipliers showing the greatest increase included the following sectors: 54.62 percent in transportation and warehousing (sector 63); 35.66 percent in agricultural, forestry, and fishery services (sector 4); 32.24 percent in paper and allied products, except containers (sector 22); 28.89 percent in other transportation equipment (sector 59); 26.46 percent in screw machine products and stamping (sector 39); 25.87 percent in new construction (sector 9); and 25.42 percent in paperboard containers and boxes (sector 23).

Estimated impacts of petroleum product price increases between 1977-1981 on Type I and Type II output multipliers of Oklahoma are presented in Table XLII. The 1981 Type I output multipliers ranged from 1.27249 for water supply and sanitary services (sector 66) to 3.01490 for livestock and livestock products (sector 1). In addition to livestock and livestock products, Type I output multipliers were highest in the following sectors: 2.89558 for food and kindred products (sector 12); 2.69301 for leather tanning and finishing (sector 31); 2.66399 for

TABLE XLII

IMPACTS OF PETROLEUM PRODUCT PRICE INCREASES OF 153 PERCENT IN OKLAHOMA AND 145 PERCENT IN REST OF U.S. BETWEEN 1977-1981 ON OUTPUT MULTIPLIERS, OKLAHOMA, 1981 (1977 DOLLARS)

	Input-Output Sector	1981 Output Multipliers Type I	1981 Output Multipliers Type II	1977-81 Percent Change Type I	1977-81 Percent Change Type II
1.	Livestock and livestock products	3.01490	6.33884	3.26	2.12
2.	Crops and other agricultural products	1.82083	3.59738	5.06	3.15
3.	Forestry and fishery products	1.93972	4.25844	4.31	2.60
4.	Agricultural, forestry and fishery services	2.31204	6.97913	2.45	16.95
5.	Iron and ferroalloy ores mining	--	--	--	--
6.	Nonferrous metal ores mining	1.97884	4.69053	4.67	2.24
7.	Stone and clay mining and quarrying	1.77198	3.86777	4.24	3.31
8.	Chemical and fertilizer mineral mining	1.61572	2.40714	6.30	3.36
9.	New construction	2.16831	6.89073	4.27	1.51
10.	Maintenance and repair construction	1.93641	5.24335	4.53	2.75
11.	Ordnance and accessories	2.05298	4.03878	3.60	2.78
12.	Food and kindred products	2.89558	6.17511	4.18	2.26
13.	Tobacco manufacturers	--	--	--	--
14.	Broad and narrow fabrics, yarn and thread mills	2.13473	4.51136	4.12	3.00
15.	Miscellaneous textile goods and floor coverings	2.27512	5.38919	4.06	2.47
16.	Apparel	2.50954	6.87498	3.52	1.87
17.	Miscellaneous fabricated textile products	2.09300	5.36261	3.72	2.77

TABLE XLII (Continued)

Input-Output Sector	1981 Output Multipliers Type I	1981 Output Multipliers Type II	1977-81 Percent Change Type I	1977-81 Percent Change Type II
18. Lumber and wood products, except containers	2.12242	4.99701	5.52	2.73
19. Wood containers	1.81486	5.97873	5.74	2.20
20. Household furniture	2.16914	6.19719	4.70	2.25
21. Other furniture and fixtures	1.94488	5.99961	4.52	2.27
22. Paper and allied products, except containers	2.46898	5.55589	2.02	1.07
23. Paperboard containers and boxes	2.61924	6.86644	4.84	1.23
24. Printing and publishing	2.17371	6.18482	4.47	2.18
25. Chemicals and selected chemical products	2.05422	4.38866	4.14	1.65
26. Plastics and synthetic materials	2.34497	5.16430	4.34	2.39
27. Drugs, cleaning and toilet preparations	2.22891	6.34909	3.61	2.01
28. Paints and allied products	2.47950	6.43610	4.55	1.79
29. Paving and roofing material	1.40654	2.73445	6.19	3.14
30. Rubber and miscellaneous plastic products	2.02884	4.80187	4.57	2.86
31. Leather tanning and finishing	2.69301	4.99230	2.97	2.55
32. Footwear and other leather products	2.21955	6.23825	3.91	1.89
33. Glass and glass products	1.97654	6.13591	4.69	1.55
34. Stone and clay products	2.17708	5.64912	5.54	1.48
35. Primary iron and steel manufacturing	2.33708	6.30404	4.82	1.48
36. Primary nonferrous metal manufacturing	2.61470	7.13892	4.74	0.81
37. Metal containers	2.58666	5.94143	4.65	1.08
38. Heating, plumbing and structural metal products	2.11326	6.02078	4.82	2.35

TABLE XLII (Continued)

	Input-Output Sector	1981 Output Multipliers Type I	Type II	1977-81 Percent Change Type I	Type II
39.	Screw machine products and stamping	2.16119	6.54887	4.06	0.97
40.	Other fabricated metal products	1.89139	4.85120	4.53	3.00
41.	Engines and turbines	2.12327	4.23169	4.29	3.20
42.	Farm and garden machinery	2.23842	6.00924	4.44	2.34
43.	Construction and mining machinery	2.06908	5.98319	4.41	2.32
44.	Materials handling machinery and equipment	2.07313	5.06550	4.32	2.56
45.	Metal working machinery and equipment	1.86128	5.47433	4.09	1.85
46.	Special industry machinery and equipment	2.08276	5.10778	4.29	2.91
47.	General industrial machinery and equipment	1.95518	5.93201	4.53	2.40
48.	Miscellaneous machinery except electrical	1.91836	5.77618	4.51	2.50
49.	Office, computing and accounting machines	2.44395	5.15576	3.39	2.93
50.	Service industry machines	2.09047	5.89214	4.28	1.45
51.	Electric industrial equipment and apparatus	2.11192	6.01528	4.33	2.36
52.	Household appliances	2.17674	6.41244	3.99	2.02
53.	Electric lighting and wiring equipment	1.96351	3.71628	4.10	3.15
54.	Radio, TV and communication equipment	1.88537	4.98623	3.27	3.00
55.	Electronic components and accessories	1.89889	3.89813	3.69	3.25
56.	Miscellaneous electrical machinery and supplies	2.00316	4.51003	4.09	2.78
57.	Motor vehicles and equipment	2.01289	5.36430	3.75	2.45

TABLE XLII (Continued)

	Input-Output Sector	1981 Output Mulitpliers Type I	Type II	1977-81 Percent Change Type I	Type II
58.	Aircrafts and parts	2.02501	6.75059	3.59	1.95
59.	Other transportation equipment	2.65118	8.34206	4.05	0.50
60.	Scientific and controlling instruments	1.76425	4.87143	3.81	2.95
61.	Optical, ophthalmic, and photo equipment	1.83051	4.05126	3.99	3.29
62.	Miscellaneous manufacturing	2.15690	5.86626	4.45	2.44
63.	Transportation and warehousing	2.09981	5.43062	3.33	2.05
64.	Communications, except radio and TV	1.41475	5.50483	2.02	2.68
65.	Radio and TV broadcasting	1.99715	6.43560	2.18	1.95
66.	Water supply and sanitary services	1.27249	3.58740	1.98	3.47
67.	Wholesale and retail trade	1.45222	6.42082	2.30	2.01
68.	Finance and insurance	1.93765	6.72065	2.17	2.00
69.	Real estate and rental	1.41744	2.36845	2.05	3.10
70.	Hotels; personal and repair service except auto	1.82810	5.35874	2.79	2.65
71.	Business services	1.92592	5.20658	3.22	2.57
72.	Eating and drinking places	2.66399	5.78253	4.02	2.43
73.	Automobile repair and services	2.10915	5.24117	3.06	1.76
74.	Amusements	2.00015	6.13522	2.74	19.11
75.	Health, educational and social services and nonprofit organizations	1.71187	7.09213	2.89	1.44
76.	Federal government enterprises	1.71197	5.45075	6.12	1.50
77.	State and local government enterprises	1.92800	4.91345	3.73	1.78
78.	Petroleum products production	1.13802	3.08746	-11.34	3.17
79.	Natural gas production	1.38470	4.18756	4.09	-25.16
80.	Coal mining	1.56085	4.18212	3.99	3.15
81.	Electricity and hydropower	1.88813	4.32056	2.83	-4.15

eating and drinking places (sector 72); 2.65118 for other transportation equipment (sector 59); 2.61924 for paperboard containers and boxes (sector 23); 2.61470 for primary nonferrous metal manufacturing (sector 36); 2.58666 for metal containers (sector 37); and 2.50954 for apparel (sector 16). The 1981 Type II output multipliers ranged from 2.36845 for real estate and rental (sector 69) to 8.34206 for other transportation equipment (sector 59). Type II output multipliers were highest in the following sectors: 7.13892 in primary nonferrous metal manufacturing (sector 36); 7.09213 in health, educational and social services and nonprofit organizations (sector 75); 6.97913 in agricultural, forestry and fishery services (sector 4); 6.89073 in new construction (sector 9); 6.87498 in apparel (sector 16); 6.86644 for paperboard containers and boxes (sector 23); 6.75059 for aircrafts and parts (sector 58); 6.72065 for finance and insurance (sector 68) and 6.54887 for screw machine products and stamping (sector 39).

Petroleum product price increases raised the 1981 Type I output multipliers of all processing sectors except petroleum product production (sector 78). The increases ranged from 1.98 percent in water supply and sanitary services (sector 66) to 6.30 percent in chemical and fertilizer mineral mining (sector 8). The 1981 Type I output multiplier of petroleum products production (sector 78) decreased 11.34 percent below the 1977 level. The 1981 Type I output multipliers increased most in the following sectors: 6.30 percent in chemical and fertilizer mineral mining (sector 8); 6.19 percent in paving and roofing material (sector 29); 6.12 percent in federal government enterprises (sector 76); 5.74 percent in wood containers (sector 19); 5.54 percent in stone and clay products (sector 34); 5.52 percent in lumber and wood products except containers (sector 18); and 5.06 percent in crops and other agricultural products (sector 2).

Type II output multipliers increased most in amusements (sector 74) and agricultural, forestry and fishery services (sector 4) with increases of 19.11 percent and 16.95 percent, respectively. Type II output multipliers of all other sectors except natural gas production (sector 79) and electricity and hydropower (sector 81) increased from 0.5 percent in other transportation equipment (sector 59) to 3.47 percent in water supply and sanitary services (sector 66). The 1981 Type II output multipliers of natural gas production (sector 79) and electricity and hydropower (sector 81) decreased 25.16 percent and 4.15 percent, respectively, as a result of petroleum price increases.

Impacts of Natural Gas Price Increases Between 1977 and 1981

Estimated impacts of natural gas price increases of 66 percent in Oklahoma and 55 percent in the Rest of U.S. between 1977 and 1981 on value added coefficients and multipliers are presented in Table XLIII. Value added coefficients for Oklahoma in 1981 ranged from 0.13709 for livestock and livestock products (sector 1) to 0.85474 for water supply and sanitary services (sector 66). Value added coefficients were highest in the following sectors: 0.85474 for water supply and sanitary services (sector 66); 0.85170 for natural gas production (sector 79); 0.82306 for petroleum products production (sector 78); 0.79598 for paving and roofing materials (sector 29); 0.78115 for communication,

TABLE XLIII

IMPACTS OF NATURAL GAS PRICE INCREASES OF 66 PERCENT IN OKLAHOMA AND 55 PERCENT IN REST OF U.S. BETWEEN 1977-1981 ON VALUE ADDED COEFFICIENTS AND VALUE ADDED MULTIPLIERS, OKLAHOMA, 1981 (1977 DOLLARS)

		1981 Value Added			1977-81 Percent Change		
		Coefficients	Multipliers		Coefficients	Multipliers	
			Type I	Type II		Type I	Type II
1.	Livestock and livestock products	0.13709	7.29461	33.98539	-1.31	1.33	4.24
2.	Crops and other agricultural products	0.55678	1.79605	2.25730	-0.99	1.00	2.51
3.	Forestry and fishery products	0.53313	1.87572	2.43972	-2.13	2.17	4.09
4.	Agricultural, forestry and fishery services	0.33409	2.99325	18.56140	-3.06	3.16	7.14
5.	Iron and ferroalloy ores mining	--	--	--	--	--	--
6.	Nonferrous metal ores mining	0.49332	2.02710	3.16159	-2.89	3.08	5.29
7.	Stone and clay mining and quarrying	0.61072	1.63740	2.11183	-1.00	1.01	2.78
8.	Chemical and fertilizer mineral mining	0.68211	1.46605	1.47674	-1.03	1.05	1.71
9.	New construction	0.43747	2.38575	35.93858	-1.42	1.44	5.57
10.	Maintenance and repair construction	0.54524	1.83406	3.50169	-0.92	0.92	3.78
11.	Ordnance and accessories	0.48678	2.05430	2.15586	-2.50	2.56	4.16
12.	Food and kindred products	0.26645	3.75299	7.14565	-1.36	1.37	4.24
13.	Tobacco manufacturers	--	--	--	--	--	--
14.	Broad and narrow fabrics, yarn and thread mills	0.46469	2.15196	2.74698	-1.34	1.36	3.38
15.	Miscellaneous textile goods and floor coverings	0.41229	2.42547	4.16602	-1.48	1.50	4.19
16.	Apparel	0.32891	3.04034	19.18374	-1.08	1.09	4.92
17.	Miscellaneous fabricated textile products	0.49257	2.03015	3.79008	-0.82	0.82	3.66
18.	Lumber and wood products, except containers	0.47577	2.10187	3.38039	-1.37	1.39	3.87

TABLE XLIII (Continued)

	1981 Value Added Coefficients	1981 Value Added Multipliers Type I	1981 Value Added Multipliers Type II	1977-81 Percent Change Coefficients	1977-81 Percent Change Multipliers Type I	1977-81 Percent Change Multipliers Type II
19. Wood containers	0.62683	1.59534	5.36487	-1.07	1.08	4.70
20. Household furniture	0.45794	2.18371	7.41175	-0.98	0.98	4.51
21. Other furniture and fixtures	0.56161	1.78061	5.49551	-1.01	1.02	4.54
22. Paper and allied products, except containers	0.25990	3.84759	6.57874	-3.95	4.11	6.62
23. Paperboard containers and boxes	0.30263	3.30439	35.73572	-2.37	2.43	6.14
24. Printing and publishing	0.46018	2.17306	7.29810	-1.10	1.11	4.60
25. Chemicals and selected chemical products	0.43286	2.31022	3.20469	-4.12	4.30	6.12
26. Plastics and synthetic materials	0.34116	2.93116	5.10668	-2.08	2.13	4.52
27. Drugs, cleaning and toilet preparations	0.40397	2.47544	15.92026	-1.10	1.11	4.68
28. Paints and allied products	0.31888	3.13595	31.55902	-1.74	1.77	5.21
29. Paving and roofing material	0.79598	1.25631	1.48337	-1.91	1.95	2.99
30. Rubber and miscellaneous plastic products	0.53362	1.87401	2.93205	-1.34	1.36	3.73
31. Leather tanning and finishing	0.31088	3.21672	3.29493	-1.89	1.92	3.85
32. Footwear and other leather products	0.45212	2.21181	7.58840	-1.24	1.26	4.75
33. Glass and glass products	0.51900	1.92677	7.63377	-2.64	2.71	6.26
34. Stone and clay products	0.42855	2.33343	5.84644	-2.87	2.95	5.89
35. Primary iron and steel manufacturing	0.39890	2.50688	7.98371	-2.56	2.62	6.04
36. Primary nonferrous metal manufacturing	0.31351	3.18973	20.20686	-3.11	3.21	7.15
37. Metal containers	0.30771	3.24977	5.10023	-3.77	3.91	6.75
38. Heating, plumbing and structural metal products	0.52051	1.92119	4.89480	-1.21	1.22	4.62
39. Screw machine products and stamping	0.46005	2.17367	12.15158	-2.92	3.01	6.76
40. Other fabricated metal products	0.60611	1.64986	2.66396	-1.11	1.12	3.66
41. Engines and turbines	0.48903	2.04487	2.13579	-1.66	1.68	3.46
42. Farm and garden machinery	0.43647	2.29112	5.12735	-1.28	1.30	4.58

TABLE XLIII (Continued)

	1981 Value Added Coefficients	1981 Value Added Multipliers Type I	1981 Value Added Multipliers Type II	1977-81 Percent Change Coefficients	1977-81 Percent Change Multipliers Type I	1977-81 Percent Change Multipliers Type II
43. Construction and mining machinery	0.51499	1.94178	4.86325	-1.23	1.24	4.65
44. Materials handling machinery and equipment	0.50326	1.98705	3.03326	-2.06	2.10	4.63
45. Metal working machinery and equipment	0.58726	1.70284	3.71503	-2.49	2.56	5.60
46. Special industry machinery and equipment	0.50209	1.99169	2.97262	1.17	1.18	3.79
47. General industrial machinery and equipment	0.57542	1.74059	4.40166	-1.08	1.09	4.55.
48. Miscellaneous machinery except electrical	0.58726	1.70282	4.12151	1.01	1.02	4.36
49. Office, computing and accounting machines	0.32640	3.06376	3.45286	-0.93	0.94	3.29
50. Service industry machines	0.48871	2.04619	4.90515	-2.65	2.72	5.96
51. Electric industrial equipment and apparatus	0.49879	2.00483	5.18096	-1.10	1.11	4.50
52. Household appliances	0.44958	2.22432	9.13820	-1.24	1.26	4.94
53. Electric lighting and wiring equipment	0.54548	1.83325	1.92354	-2.10	2.05	3.47
54. Radio, TV and communication equipment	0.56247	1.77789	3.06134	-0.63	0.63	3.30
55. Electronic components and accessories	0.56004	1.78558	2.06217	-1.36	1.38	3.05
56. Miscellaneous electrical machinery and supplies	0.52783	1.89455	2.52218	-1.99	2.03	4.12
57. Motor vehicles and equipment	0.50951	1.96269	3.91480	-1.45	1.47	4.34
58. Aircrafts and parts	0.51808	1.93020	9.57449	-0.81	0.81	4.95
59. Other transportation equipment	0.25337	3.94672	6.06447	-1.82	1.86	6.93
60. Scientific and controlling instruments	0.64063	1.56095	2.73760	-0.90	0.91	3.57
61. Optical, ophthalmic, and photo equipment	0.60685	1.64785	2.10305	-1.06	1.07	2.95

TABLE XLIII (Continued)

	1981 Value Added			1977-81 Percent Change		
	Coefficients	Multipliers		Coefficients	Multipliers	
		Type I	Type II		Type I	Type II
62. Miscellaneous manufacturing	0.47751	2.09418	4.91157	-1.09	1.10	4.32
63. Transportation and warehousing	0.37315	2.67991	7.48790	-1.60	1.62	4.44
64. Communications, except radio and TV	0.78115	1.28016	3.72622	-0.31	0.31	3.82
65. Radio and TV broadcasting	0.46952	2.12984	13.63596	-0.82	0.82	4.64
66. Water supply and sanitary services	0.85474	1.16994	1.75146	-0.52	0.52	2.46
67. Wholesale and retail trade	0.76180	1.31267	8.47553	-0.50	0.50	4.78
68. Finance and insurance	0.51100	1.95695	14.51774	-0.42	0.42	4.55
69. Real estate and rental	0.76966	1.29928	1.39631	-0.20	0.20	1.00
70. Hotels; personal and repair service except auto	0.56647	1.76532	4.25423	-0.68	0.68	3.71
71. Business services	0.51668	1.93544	4.04014	-1.00	1.00	3.80
72. Eating and drinking places	0.33834	2.95565	5.06876	-1.26	1.27	3.98
73. Automobile repair and services	0.40886	2.44582	4.53863	-2.52	2.59	5.20
74. Amusements	0.48035	2.08180	9.48806	-0.98	0.99	4.53
75. Health, educational and social services and nonprofit organizations	0.63439	1.57631	3.91806	-0.80	0.81	5.10
76. Federal government enterprise	0.65070	1.53681	4.22819	-2.58	2.64	5.80
77. State and local government enterprise	0.51029	1.95968	3.49922	-2.93	3.02	5.46
78. Petroleum products production	0.82306	1.21498	1.59225	-1.58	1.61	3.02
79. Natural gas production	0.85170	1.17413	2.15559	7.39	-6.88	-51.10
80. Coal mining	0.70841	1.41162	2.28423	-1.11	-1.12	3.32
81. Electricity and hydropower	0.39556	2.52807	3.42530	-14.73	17.27	18.46

except radio and TV (sector 64); 0.76966 for real estate and rental (sector 69); 0.76180 for wholesale and retail trade (sector 67); and 0.70841 for coal mining (sector 80).

When the impacts of natural gas price increases on commodity prices were included in the modified interregional input-output price model, the value added coefficients of all processing sectors in Oklahoma in 1981 except natural gas production (sector 79) decreased. The decrease ranged from 0.2 percent in real estate and rental (sector 69) to 14.73 percent in electricity and hydropower (sector 81). The value added coefficient of natural gas production (sector 79) increased 7.39 percent Value added coefficients decreased most in the following sectors: 14.73 percent in electricity and hydropower (sector 81); 4.12 percent in chemicals and selected chemical products (sector 25); 3.95 percent in paper and allied products, except containers (sector 22); 3.77 percent in metal containers (sector 37); and 3.06 percent in agricultural, forestry and fishery services (sector 4).

Type I value added multipliers of Oklahoma in 1981 including the impact of natural gas price increases ranged from 1.16994 for water supply and sanitary services (sector 66) to 7.294661 for livestock and livestock products (sector 1). Type I value added multipliers were highest in the following sectors: 7.29461 for livestock and livestock products (sector 1); 3.94672 for other transportation equipment (sector 59); 3.84759 for paper and allied products, except containers (sector 22); 3.75299 for food and kindred products (sector 12); 3.30439 for paperboard containers and boxes (sector 23); 3.24977 for metal containers (sector 37); 3.21672 for leather tanning and finishing (sector 31); 3.18973 for primary nonferrous metal manufacturing (sector 36), and 3.13595 for paints and allied products (sector 28).

The 1981 Type II value added multipliers ranged from 1.39631 for real estate and rental (sector 69) to 35.93858 for new construction (sector 9). Type II value added multipliers were highest in the following sectors: 35.93858 for new construction (sector 9); 35.73572 for paperboard containers and boxes (sector 23); 33.98539 for livestock and livestock products (sector 1); 31.55902 for paints and allied products (sector 28); 20.20686 for primary nonferrous metal manufacturing (sector 36); 19.18374 for apparel (sector 16); 18.56140 for agricultural, forestry, and fishery services (sector 4); and 15.92026 for drugs, cleaning and toilet preparation (sector 27).

Increases in natural gas prices raised the 1981 Type I value added multipliers of all processing sectors except natural gas production (sector 79) from 0.2 percent in real estate and rental (sector 69) to 17.27 percent in electricity and hydropower (sector 81). The Type I value added multiplier of natural gas production (sector 79) decreased 6.88 percent below the 1977 level. The 1981 value added multipliers increased most in the following sectors: 17.27 percent in electricity and hydropower (sector 81); 4.30 percent in chemical and selected chemical products (sector 25); 4.11 percent in paper and allied products, except containers (sector 22); 3.91 percent in metal containers (sector 37); 3.21 percent in primary nonferrous metal manufacturing (sector 36); and 3.16 percent in agricultural, forestry and fishery services (sector 4).

Natural gas price increases raised Type II value added multipliers of all processing sectors except natural gas production (sector 79) from

1.0 percent in real estate and rental (sector 69) to 18.46 percent in electricity and hydropower (sector 81). The Type II value added multiplier of natural gas production (sector 79) decreased 51.10 percent below the 1977 level. The 1981 Type II value added multipliers increased most in the following sectors: 18.46 percent in electricity and hydropower (sector 81); 7.15 percent in primary nonferrous metal manufacturing (sector 36); 7.14 percent in agricultural, forestry, and fishery services (sector 4); 6.93 percent in other transportation equipment (sector 59); 6.76 percent in screw machine products and stamping (sector 39); 6.75 percent in metal containers (sector 37); 6.62 percent in paper and allied products, except container (sector 22); 6.26 percent in glass and glass products (sector 33); 6.14 percent in paperboard containers and boxes (sector 23); and 6.12 percent in chemicals and selected chemical products (sector 25).

Estimated impacts of natural gas price increases between 1977 and 1981 on Type I and Type II output multipliers of Oklahoma are presented in Table XLIV. The 1981 Type I output multipliers ranged from 1.23395 for natural gas production (sector 79) to 2.95076 for livestock and livestock products (sector 1). In addition to livestock and livestock products, Type I output multipliers were highest in the following sectors: 2.81172 for food and kindred products; 2.64333 for leather tanning and finishing (sector 31); 2.59030 for eating drinking places (sector 72); 2.54700 for primary nonferrous metal manufacturing (sector 36); 2.53724 for paperboard containers and boxes (sector 23); and 2.50474 for metal containers (sector 37). Type II output multipliers ranged from 2.03068 for petroleum products production (sector 78) to 8.35045 for other transportation equipment (sector 59). Type II output

TABLE XLIV

IMPACTS OF NATURAL GAS PRICE INCREASES OF 66 PERCENT IN OKLAHOMA AND
55 PERCENT IN REST OF U.S. BETWEEN 1977-1981 ON
OUTPUT MULTIPLIERS, OKLAHOMA, 1981
(1977 DOLLARS)

Input-Output Sector	1981 Output Multipliers		1977-81 Percent Change	
	Type I	Type II	Type I	Type II
1. Livestock and livestock products	2.95076	6.47504	1.07	4.32
2. Crops and other agricultural products	1.75305	3.69983	1.15	6.09
3. Forestry and fishery products	1.88594	4.35071	1.42	4.83
4. Agricultural, forestry and fishery services	2.28116	6.75897	1.09	13.26
5. Iron and ferroalloy ores mining	--	--	--	--
6. Nonferrous metal ores mining	1.93530	4.80199	2.37	4.67
7. Stone and clay mining and quarrying	1.72362	4.10911	1.40	9.76
8. Chemical and fertilizer mineral mining	1.54349	2.54839	1.55	9.42
9. New construction	2.10792	6.98374	1.37	2.88
10. Maintenance and repair construction	1.87619	5.45168	1.29	6.83
11. Ordnance and accessories	2.01438	4.34372	1.66	10.54
12. Food and kindred products	2.81172	6.43982	1.17	6.64
13. Tobacco manufacturers	--	--	--	--
14. Broad and narrow fabrics, yarn and thread mills	2.08024	4.82456	1.46	10.15
15. Miscellaneous textile goods and floor coverings	2.21559	5.72010	1.34	8.77
16. Apparel	2.45272	7.12137	1.17	5.52
17. Miscellaneous fabricated textile products	2.04179	5.68849	1.19	9.01

TABLE XLIV (Continued)

	Input-Output Sector	1981 Output Multipliers Type I	Type II	1977-81 Percent Change Type I	Type II
18.	Lumber and wood products, except containers	2.04058	5.27463	18.90	8.44
19.	Wood containers	1.74130	6.13961	1.46	4.95
20.	Household furniture	2.09953	6.45501	1.34	6.50
21.	Other furniture and fixtures	1.88603	6.26834	1.36	6.85
22.	Paper and allied products, except containers	2.45003	5.50709	1.24	0.18
23.	Paperboard containers and boxes	2.53724	7.01221	1.56	3.38
24.	Printing and publishing	2.10868	6.45009	1.34	6.56
25.	Chemicals and selected chemical products	2.00953	4.51466	1.88	4.57
26.	Plastics and synthetic materials	2.28586	5.40885	1.71	7.24
27.	Drugs, cleaning and toilet preparations	2.17728	6.50885	1.21	4.57
28.	Paints and allied products	2.40933	6.65657	1.59	5.28
29.	Paving and roofing material	1.34699	2.95302	1.70	11.38
30.	Rubber and miscellaneous plastic products	1.97110	5.12275	1.59	9.74
31.	Leather tanning and finishing	2.64333	5.23279	1.07	7.49
32.	Footwear and other leather products	2.16358	6.50149	1.29	6.19
33.	Glass and glass products	1.92006	6.35646	1.70	5.20
34.	Stone and clay products	2.09665	5.87217	1.65	5.49
35.	Primary iron and steel manufacturing	2.27182	6.51632	1.90	4.89
36.	Primary nonferrous metal manufacturing	2.54700	7.38615	2.03	4.30
37.	Metal containers	2.50474	6.30226	1.34	7.21
38.	Heating, plumbing and structural metal products	2.05027	6.31796	1.69	7.41

TABLE XLIV (Continued)

	Input-Output Sector	1981 Output Multipliers Type I	Type II	1977-81 Percent Change Type I	Type II
39.	Screw machine products and stamping	2.11959	6.66108	2.06	2.70
40.	Other fabricated metal products	1.83874	5.18276	1.62	10.04
41.	Engines and turbines	2.06950	4.58222	1.65	11.75
42.	Farm and garden machinery	2.17618	6.30205	1.53	7.32
43.	Construction and mining machinery	2.01408	6.29551	1.63	7.67
44.	Materials handling machinery and equipment	2.02745	5.42791	2.02	9.90
45.	Metal working machinery and equipment	1.82478	5.80154	2.05	7.94
46.	Special industry machinery and equipment	2.02832	5.46398	1.56	10.09
47.	General industrial machinery and equipment	1.90054	6.24184	1.61	7.75
48.	Miscellaneous machinery except electrical	1.86380	6.08223	1.54	7.93
49.	Office, computing and accounting machines	2.38946	5.51498	1.09	10.10
50.	Service industry machines	2.03446	6.25432	1.49	7.68
51.	Electric industrial equipment and apparatus	2.05459	6.32031	1.50	7.55
52.	Household appliances	2.12453	6.56423	1.50	4.43
53.	Electric lighting and wiring equipment	1.91836	4.03716	1.71	12.06
54.	Radio, TV and communication equipment	1.84524	5.33373	1.07	10.18
55.	Electronic components and accessories	1.85886	4.22832	1.51	11.99
56.	Miscellaneous electrical machinery and supplies	1.95813	4.79548	1.75	9.28
57.	Motor vehicles and equipment	1.96830	5.70187	1.45	8.89

TABLE XLIV (Continued)

	Input-Output Sector	1981 Output Multipliers		1977-81 Percent Change	
		Type I	Type II	Type I	Type II
58.	Aircrafts and parts	1.97807	6.99253	1.19	5.60
59.	Other transportation equipment	2.58477	8.35045	1.44	0.60
60.	Scientific and controlling instruments	1.72221	5.21170	1.33	10.14
61.	Optical, ophthalmic, and photo equipment	1.78532	4.38961	1.43	11.91
62.	Miscellaneous manufacturing	2.09462	6.16041	1.44	7.57
63.	Transportation and warehousing	2.05076	4.85302	0.92	-8.81
64.	Communications, except radio and TV	1.39595	5.81552	0.66	8.48
65.	Radio and TV broadcasting	1.97208	6.70549	0.89	6.23
66.	Water supply and sanitary services	1.25944	3.90589	0.93	12.65
67.	Wholesale and retail trade	1.43134	6.65634	0.82	5.75
68.	Finance and insurance	1.90876	6.96432	0.65	5.69
69.	Real estate and rental	1.39572	2.57514	0.48	12.09
70.	Hotels; personal and repair service except auto	1.79503	5.68539	0.93	8.91
71.	Business services	1.88508	5.52625	1.03	8.87
72.	Eating and drinking places	2.59030	6.10929	1.14	8.22
73.	Automobile repair and services	2.06798	5.62491	1.04	9.21
74.	Amusements	1.96600	6.41443	0.98	6.69
75.	Health, educational and social services and nonprofit organizations	1.67965	7.27248	0.96	4.02
76.	Federal government enterprises	1.64196	5.72318	1.78	6.58
77.	State and local government enterprises	1.88852	5.27640	1.61	9.30
78.	Petroleum products production	1.30341	2.03068	1.54	-32.14
79.	Natural gas production	1.23395	5.88478	-7.24	5.17
80.	Coal mining	1.52564	4.44462	1.64	9.62
81.	Electricity and hydropower	1.89803	4.95230	3.37	9.86

multipliers were highest in the following sectors: 8.35045 for other transportation equipment (sector 59); 7.38615 for primary nonferrous metal manufacturing (sector 36); 7.27248 for health, educational, and social services and nonprofit organizations (sector 75); 7.12137 for apparel (sector 16); 7.01221 for paperboard containers and boxes (sector 23); 6.99253 for aircrafts and parts (sector 58); 6.98374 for new construction (sector 9); and 6.96432 for finance and insurance (sector 68).

Increases in natural gas prices between 1977-1981 raised Type I output multipliers of all processing sectors except natural gas production (sector 79). The increases ranged from 0.48 percent in real estate and rental (sector 69) to 18.9 percent in lumber and wood products, except containers (sector 18). Type I output multiplier of natural gas production (sector 79) decreased 7.24 percent below the 1977 level. Type I output multipliers in Oklahoma increased most in the following sectors: 18.9 percent in lumber and wood products, except containers (sector 18); 3.37 percent in electricity and hydropower (sector 81); 2.37 percent in nonferrous metal ores mining (sector 6); 2.06 percent in screw machine products and stamping (sector 39); 2.05 percent in metal working machinery and equipment (sector 45); 2.03 percent in primary nonferrous metal manufacturing (sector 36); and 2.02 percent in material handling machinery and equipment (sector 44).

Type II output multipliers of all processing sectors except transportation and warehousing (sector 63) and petroleum products production (sector 78) increased. The increases ranged from 0.18 percent in paper and allied products, except containers (sector 22) to

13.26 percent in agricultural, forestry and fishery services (sector 4). Type II output multipliers of transportation and warehousing (sector 63) and petroleum products production (sector 78) declined 8.81 percent and 32.14 percent, respectively. Type II output multipliers increased most in the following sectors: 13.26 percent in agricultural, forestry and fishery services (sector 4); 12.09 percent in real estate and rental (sector 69); 12.06 percent in electric lighting and wiring equipment (sector 53); 11.99 percent in electronic components and accessories (sector 55); 11.91 percent in optical, ophthalmic, and photo equipment (sector 61); 11.75 percent in engines and turbines (sector 41); and 11.38 percent in paving and roofing materials (sector 29).

Effects of Energy Price Changes on Sector Output, Income and Employment

One of the applications of the interregional input-output price model is to use the interregional multipliers to estimate total impacts of changes in output, income and employment. Assuming no changes in productivity of the processing sectors between 1977 and 1981, total impacts on the economy of Oklahoma in 1981 from changes in output, value added, and employment of any processing sector can be estimated by multiplying the amount of change by the corresponding 1981 interregional multiplier.

The estimated impacts of changes in output, value added and employment that occurred in petroleum products production (sector 78) from 1977 to 1981 can be used as an illustration. The following parameter data is used: 0.92072 for value added coefficient; 1.08611 for Type I value added multiplier and 1.22116 for Type II value added multiplier; 1.13802 for Type I output multiplier and 3.08746 for Type II output multiplier. Assuming that the dollar value of the output of petroleum products increased at the same rate as petroleum prices in Oklahoma between 1977-1981, the dollar value of output of petroleum products production increased from $2,902,346 thousand in 1977 to $7,342,935 thousand in 1981. With the value added coefficient of 0.92072, value added in petroleum products production in 1981 was estimated as $6,760,787,000 in 1977 dollars. When this amount of value added was multiplied by the Type I value added multiplier of 1.08611, the value added of all processing sectors in Oklahoma generated directly and indirectly was $7,342,958,000 in 1977 dollars. Using the Type II value added multiplier of 1.22116, the direct, indirect, and induced value added change of all processing sectors was estimated at $8,256,002,700 in 1977 dollars. The dollar value of output of all processing sectors in Oklahoma associated directly and indirectly with the output of petroleum products production was estimated by multiplying the Type I output multiplier of 1.13802 of petroleum products production by the dollar value of its increased output. Therefore, the direct and indirect output effects on all processing sectors in Oklahoma from changes in output of petroleum products production in 1981 was estimated at $8,356,407,000 in 1977 dollars. Using the Type II output multiplier of 3.08746, the direct, indirect, and induced output effects on all processing sectors was estimated at $22,671,018,000 in 1977 dollars.

Effects of changes in employment in petroleum products production on total employment of Oklahoma can be estimated by multiplying the employment multiplier by the change in employment of the petroleum products production sector. Employment in oil and gas extraction and refinery industry in Oklahoma increased from 54,100 persons in 1977 to 78,290 persons in 1981. Assuming that employment in petroleum products production increased at the same rate as employment in oil and gas extraction and refinery industry, employment in petroleum products production would increase from 26,546 persons in 1977 to 38,416 persons in 1981. With Type I employment multiplier of 1.65195, total direct and indirect employment effects on all processing sectors in Oklahoma from employment in petroleum products production in 1981 would be 63,461 persons. When employment of petroleum products production is multiplied by its Type II employment multiplier of 5.82041, total direct, indirect, and induced employment effects of employment in petroleum products production on total employment in Oklahoma in 1981 would be 223,597 persons.

CHAPTER X

SUMMARY, IMPLICATIONS AND LIMITATIONS

Summary

The objective of this thesis was to develop and apply the methodology of an interregional input-output price model in analyzing impacts of energy price changes on the regional economy of Oklahoma. A two-region input-output model was developed to show the structural relationships between Oklahoma and the Rest of United States. The regional technology coefficient matrices were derived from the benchmark national input-output table for the base year 1977.

A human resource account was constructed to show the allocation of household income and employment in Oklahoma and Rest of U.S. in 1977 by economic sector. The data from the human resource account were integrated with the interregional input-output model for purposes of measuring interregional output, income and employment multipliers. Interregional input-output multipliers were calculated as Type I multipliers when the household sector is exogenous of the interindustry model and as Type II multipliers when the household sector is treated as an endogenous sector of the model.

An energy balance sheet was constructed for the base period 1977 to show production and consumption of energy by energy source and by economic sector. The data of an energy account were integrated with the interregional input-output price model to evaluate the impacts of energy price increases on regional commodity prices. An interregional input-output price model was first applied to estimate impacts of a hypothetical 20 percent increase in each energy price and a 20 percent increase of all energy prices. The model was also used to estimate impacts of the actual percentage increases of petroleum product prices and natural gas prices in Oklahoma and Rest of U.S. during the period between 1977 and 1981. Finally a modified interregional input-output price model was developed to measure the final impacts of energy price changes on value added coefficients and value added and output multipliers of Oklahoma.

Implication

When petroleum product prices were hypothetically increased by 20 percent throughout the United States, transportation and warehousing (sector 63) of Oklahoma was most affected. The cost (price) of transportation and warehousing increased about 5.65 percent. Almost all other industries in Oklahoma were affected by this petroleum product price change. Commodity prices for five sectors in Oklahoma increased by more than two percent. They were paper and allied products, except containers (sector 22); agricultural, forestry, and fishery services (sector 4); forestry and fishery products (sector 3); crops and other agricultural products (sector 2); and chemicals and selected chemical products (sector 25). Prices of nine processing sectors increased from 1.01 percent to 1.92 percent, while prices of all other sectors increased by less than one percent.

When natural gas prices were hypothetically increased by 20 percent throughout the United States, electricity and hydropower (sector 81) was impacted most in Oklahoma with a price increase of 6.24 percent over the normalized price. Prices of nine processing sectors increased from 1.03 percent to 1.51 percent, while prices of all other sectors increased by less than one percent.

When coal prices were hypothetically increased by 20 percent, prices of all other commodities increased by less than one percent. When electricity and hydropower prices were hypothetically increased by 20 percent, 11 processing sectors of Oklahoma showed price increases slightly more than one percent while all other sectors showed price increases of less than one percent.

When all energy prices were hypothetically increased by 20 percent at the same time, all processing sectors of Oklahoma showed higher increases in varying proportions in commodity prices. Prices of transportation and warehousing (sector 63), paper and allied products, except containers (sector 22); chemical and selected chemical products (sector 25); nonferrous metal ores mining (sector 6); agricultural, forestry, and fishery services (sector 4); screw machine products and stamping (sector 39); and stone and clay products (sector 34) were impacted most. Prices of these sectors increased from 3.03 percent to 6.13 percent over normalized prices.

The truncated interregional input-output price model was applied to estimate impacts of actual price increases that occurred in petroleum product prices in Oklahoma and the Rest of U.S. between 1977 and 1981. As petroleum product prices increased by 153 percent in Oklahoma and 145 percent in Rest of U.S. between 1977 and 1981, other commodity prices in

Oklahoma increased widely, ranging from 1.02 percent increase in real estate and rental (sector 66) to 43.16 percent increase in transportation and warehousing (sector 63). Nine processing sectors of Oklahoma showed price increases of more than ten percent as the result of petroleum product price increases between 1977 and 1981. Sectors with the highest price increases were transportation and warehousing (sector 63); nonferrous metal ores mining (sector 6); paper and allied products, except containers (sector 22); agricultural, forestry and fishery services (sector 4); forestry and fishery products (sector 3); crops and other agricultural products (sector 2); chemical and selected chemical products (sector 25); nonferrous metal ores mining (sector 6); chemical and fertilizer mineral mining (sector 8); livestock and livestock products (sector 1); and leather tanning and finishing (sector 31). These price increases ranged from 9.6 percent to 43.16 percent over normalized prices.

Prices of other energy processing sectors in Oklahoma showed little response to increases in petroleum product price increases. Prices of natural gas production (sector 79), coal mining (sector 80), and electricity and hydropower (sector 81) increased by 5.50 percent, 5.26 percent, and 3.32 percent, respectively, as a result of the petroleum product price increases between 1977 and 1981.

The impacts of the natural gas price increase of 66 percent in Oklahoma and 45 percent in Rest of U.S. between 1977 and 1981 were to raise commodity prices in Oklahoma from 0.20 percent for real estate and rental (sector 69) to 17.28 percent for electricity and hydropower (sector 81). Sectors that were most affected by natural gas price increases are those industries having high natural gas usage ratios such as electricity and hydropower (sector 81); paper and allied products, except containers (sector 22); chemicals and selected chemical products (sector 25); metal containers (sector 37); primary nonferrous metal manufacturing (sector 36); agricultural, forestry and fishery services (sector 4); and nonferrous metal ores mining (sector 6).

The economic impact analysis considered three interregional input-output multipliers; output, income, and employment. Output multipliers measure the total change in output from all sectors resulting from a dollar change in final demand for the output of a particular sector. Type I output multipliers consider only the direct and indirect impacts of a dollar change in final demand, while Type II multipliers include the induced impacts of consumption spending. Type I output multipliers of Oklahoma ranged from 1.24783 (water supply and sanitary services) to 2.91963 (livestock and livestock products). Sectors with the highest Type I output multipliers are livestock and livestock products (2.91963); food and kindred products (2.77933); leather tanning and finishing (2.61522); eating and drinking places (2.56105); other transportation equipment (2.54798); paperboard containers and boxes (2.49837); and primary nonferrous metal manufacturing (2.49631). Type II output multipliers of Oklahoma ranged from 2.29730 (real estate and rental) to 8.30068 (other transportation equipment). Sectors with the highest Type II output multipliers are other transportation equipment (8.30068); primary nonferrous metal manufacturing (7.08154); health, educational and social services, and non-profit organizations (6.99128); new construction (6.78854); paperboard containers and boxes (6.78283); and aircraft and parts (6.62160).

Income multipliers measure the total change in income of Oklahoma resulting from a dollar change in income of a producing sector. Type I income multipliers show the direct and indirect change in Oklahoma income per dollar of change in income of a producing sector. Type II income multipliers include the induced effects of increases in income resulting from incresed consumer spending. Type I income multipliers of Oklahoma ranged from 1.15974 (natural gas production) to 24.15390 (engines and turbines). Sectors with the highest Type I income multipliers are engines and turbines (24.15390); ordnance and accessories (18.27559); electric lighting and wiring equipment (13.83421); electric lighting and wiring equipment (13.83421); office, computing and accounting machines (13.13330); and livestock and livestock products (4.59653). Type II income multipliers ranged from 2.72662 (natural gas production) to 57.82123 (engines and turbines). Type II income multipliers were highest in engines and turbines (57.82123); ordnance and accessories (43.54759); electric lighting and wiring equipment (31.96451); office, computing and accounting machines (33.01902); metal containers (11.10358);livestock and livestock products (10.93988); electronic components and accessories (10.29242); and paper and allied products, except containers (10.21773).

Employment multipliers measure the total change in employment due to a one unit change in employment of a particular sector. Type I employment multipliers show the direct and indirect change in employment of Oklahoma from a one unit change in employment of a particular sector. Type II employment multipliers include the induced employment effect from changes in income resulting from increased consumer spending. Type I employment multipliers in Oklahoma ranged from 1.10426 (plastics and synthetic materials) to 7.54205 (engines and turbines). Sectors with the highest Type I employment multipliers are engines and turbines (7.54205); food and kindred products (4.83218); chemicals and selected chemicals products (4.72198); and paper and allied products, except containers (4.50979). Employment multipliers Type II for Oklahoma ranged from 1.42075 (plastics and synthetic materials) to 22.24147 (engines and turbines). Type II employment multipliers were highest for engines and turbines (22.24147); chemicals and selected chemical products (16.18162); paper and allied products, except containers (13.38616); coal mining (12.81087); electricity and hydropower (12.19049); food and kindred products (12.11219); optical, opthalmic, and photographic equipment (11.05512), and special industry machinery and equipment (10.60923).

Increases of petroleum product prices between 1977 and 1981 reduced value added coefficients of all processing sectors of Oklahoma except petroleum products production (sector 78) below the 1977 level. Decreases ranged from 0.91 percent in water supply and sanitary services (sector 36) to 30.15 percent in transportation and warehousing (sector 63). The value added coefficient of petroleum products production increased 10.09 percent. The petroleum product price increases raised both Type I and Type II value added multipliers of all processing sectors except petroleum products production. The increases in Type I value added multipliers ranged from 0.92 percent in water supply and sanitary services (sector 66) to 43.16 percent in transportation and warehousing (sector 63). Type I value added multipliers of petroleum products production decreased 9.17 percent. Increases in Type II value added multipliers ranged from 4.68 percent in real estate and rental (sector 69) to 54.62 percent in transportation and warehousing (sector 63). Type II value added multipliers of petroleum products production decreased 20.99 percent.

Increases in Type I output multipliers ranged from 1.98 percent in water supply and sanitary services (sector 66) to 6.30 percent in chemical and fertilizer mineral mining (sector 80). Type I output multipliers of petroleum products production decreased 11.34 percent. Increases in Type II output multipliers ranged from 0.5 percent in other transportation equipment (sector 59) to 19.11 percent in amusements (sector 74). Type II output multiliers of natural gas production (sector 79) and electricity and hydropower (sector 81) decreased 25.16 percent and 4.15 percent, respectively.

The increase in natural gas prices between 1977 and 1981 decreased the value added coefficients of all processing sectors in Oklahoma except natural gas production (sector 79). The decrease ranged from 0.2 percent in real estate and rental (sector 69) to 14.73 percent in electricity and hydropower (sector 81). Value added coefficient of natural gas production (sector 81) increased 7.39 percent. Type I value added multipliers increased; ranging from 0.2 percent in real estate and rental (sector 69) to 17.27 percent in electricity and hydropower (sector 81). Type I value added multiplier of natural gas production (sector 79) decreased 6.88 percent. Type II value added multipliers increased ranging from 1.0 percent in real estate and rental (sector 69) to 18.46 percent in electricity and hydropower (sector 81). Type II value added multiplier of natural gas production (sector 79) decreased 51.10 percent.

Increases in natural gas prices raised Type I output multipliers of all processing sectors except natural gas production (sector 79); ranging from 0.48 percent in real estate and rental (sector 69) to 18.9 percent in lumber and wood products, except containers (sector 18). Type I output multiplier of natural gas production decreased 7.24 percent. Increases in Type II output multipliers ranged from 0.18 percent in paper and allied products, except containers (sector 22) to 13.26 percent in agricultural, forestry and fishery services (sector 4). Type II output multipliers of transportation and warehousing (sector 63) and petroleum products production (sector 78) declined 8.81 percent and 32.14 percent, respectively.

Limitations

Limitations for the study area arise from (1) data limitation and (2) model assumptions. The study used secondary data based on national coefficients. Data limitations occur since a vast amount of data are required and time and funds prohibit the collection of primary data. With primary data, the model could have been developed in greater detail, permitting a more comprehensive analysis.

The interregional input-output model has important data limitations. Since the national input-output tables have not yet been published for the base year 1977, they had to be estimated from the previous input-output tables using an extrapolation technique. The interregional input-output coefficients were estimated using 1963 trade coefficients. With more recent trade data, the interregional input-output model would better depict interregional linkages between Oklahoma and the Rest of U.S.

The human resource account has data limitations of household income disaggregation by economic sector. Without appropriate data of unearned income, the allocation of household income by economic sector was forced to cover only wage and salary and other labor income and proprietor's income. Unearned income such as dividends, rent, interest, and transfer payments has significance in computing household income and consumption spending. Hence, it has significance in calculating income multipliers and Type II output and employment multipliers when the household sector is an endogenous sector of the model.

The energy account has data limitations by sector disaggregation and energy source both for processing and final demand sectors. Various data sources and allocation rules were used to distribute energy consumption to the detailed input-output sectors of Oklahoma. Some of the allocation procedures were arbitrary. The allocation rules have relied only on secondary data sources and not primary data or field observations. With better quality of energy data, the ability of an interregional input-output price model to predict the impacts of energy price changes will be increased significantly.

Model assumptions are also limitations to the study. The interregional input-output price model was based on three basic assumptions, i.e. (1) fixed technical coefficients, (2) fixed trade relationships, and (3) constant industrial shares for each industry in a region. These assumptions restrict the use of the truncated interregional input-output price model to short-run price forecasts in which technical and trade relationships do not adjust to the shifts in relative prices of inputs. In the long run, the technical and trade relationships will change, and price forecasts will become increasingly inaccurate. A modified interregional input-output price model is an attempt to use the estimated prices to update the technical coefficients to account for changes in technical relationships over time due to price changes. However, the modified interregional input-output price model does not account for changes in technical relationships over time due to changes in technology. To account for changes in technology over time, the model should include the effects of capital formation on current and future production. The capital account has to be developed and integrated with the static interregional input-output model so that it can account for the expansion of capital stock to meet new levels of final demands resulting from changes in commodity prices.

Additional Research

Further research is needed to alleviate the above mentioned data and model limitations. With better data, a more comprehensive analysis of an interregional input-output model can be made. Further studies in this area should address the impacts of energy price changes on output, income, employment and government revenues. A modification of an interregional input-output model can be made to include the impacts of energy price changes on input-output coefficients by pre-multiplying the initial input-output coefficient matrix by the matrix of new commodity prices and post-multiplying by the inverse matrix of new commodity prices. Then an econometric model can be developed to estimate the impacts of commodity price changes on final demand components of the interregional input-output model. Once the new final demand components are estimated, changes in outputs of processing sectors can be estimated using the new input-output coefficient matrices. Then impacts of new commodity prices on income, employment and government revenues are determined using the appropriate coefficients of the interregional input-output model.

Another important area of research will be the long-run forecast of final impacts of energy price changes on consumption, investment, employment, and government revenues and expenditures. With the complete data on capital formation, a simulation model can be built around a dynamic interregional input-output price model. With a set of properly defined equations, the impacts of energy price changes on regional economic variables such as consumption expenditure, investment, employment, income and government revenues and expenditures can be forecasted for future time periods.

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APPENDIX A

METHODS AND SOURCES USED FOR CONSTRUCTION OF SECTOR TOTAL OUTPUT

Classification Industries

The individual regional input-output model consists of 81 procesing (or purchasing) sectors, six dummy and special industries, and nine final demand sectors. Processing sectors of the regional model consists of four sectors of agricultural activities, four sectors of mining except fuels, two sectors of construction, 52 sectors of manufacturing, 13 sectors of service-type activities, two government sectors and four energy producing sectors. Industrial aggregation and classification by Standard Industrial Classification (SIC) codes of both Oklahoma and Rest of U.S. are as presented in Table VII of Chapter IV. All data are in 1977 prices.

Sector total output of procesing sectors of both Oklahoma and Rest of U.S. are presented in Table VII of Chapter IV. The method and data sources used for construction of sector total output of Rest of U.S. model followed the Bureau of Economic Analysis, Definitions and Convention of 1972 Input-Output Study (90). The readers are referred to this publication for more details. The method and data sources used for construction of total output of energy processing sectors of Oklahoma are described in the energy account of Chapter VI. Methods and sources used for construction of total output of non-energy processing sectors of Oklahoma in 1977 are as described below.

Definition of Industries and Sources of Data

Agricultural, Forestry and Fishery Sector

The output of the agricultural industries is the value of all farm production. It is defined on a commodity basis. The output total for a given industry covers all farm production of the products primary to that industry, whether they are produced for sale or for their own use and whether or not they are produced on farms whose major products were primary to that industry.

Detailed information for the value of the agricultural commodities in 1977 are obtained mainly from the Oklahoma Agricultural Statistics, 1980 (78). The data are supplemented by the Economic Indicators of the Farm Sector (107), 1977 Fisheries of the United States (122) and 1974 Census of Agriculture (112) and 1978 Census of Agriculture (113).

Livestock and Livestock Products

The output of this industry includes the output of primary products and secondary products and receipts. The major secondary receipts are the farm rental received and secondary dairy products. The list of items included and estimated values are presented in Table XLV. Farm rental received are allocated to livestock and livestock products and to other agricultural products (mainly crops) by assuming each sector's share in proportion to their total output.

Other Agricultural Products

The output of this industry includes farm production for open market sale. It includes a portion of farm rental received and government payments. The estimated values of the components included in this industry are presented in Table XLVI.

TABLE XLV

ESTIMATED OUTPUT FOR LIVESTOCK AND LIVESTOCK PRODUCTS OKLAHOMA, 1977

Components	Values ($1,000)
Cattle and calves	960,500
Hogs and pigs	18,480
Sheep and lambs	2,520
Wool	337
Farm Dairy Products	111,936
Chickens	5,115
Turkeys	6,692
Eggs	25,162
Honey and Beeswax	1,464
Farm Rental Received	72,908
TOTAL	1,205,114

Forestry and Fishery Products

The output of this industry includes raw furs, standing timber, Christmas trees, tree seeds and seedlings, gums, barks and miscellaneous forest products and products of fisheries. The estimated values of the items produced in Oklahoma includes the following:

Components	Value ($1,000)
Forest	1,153
Greenhouse and nursery	23,748
Fishery products	503
TOTAL	25,404

TABLE XLVI

ESTIMATED OUTPUT FOR OTHER AGRICULTURAL PRODUCTS
OKLAHOMA, 1977

Components	Values ($1,000)
Wheat	407,160
Oats	8,073
Barley	6,468
Rye	1,583
Corn for grain	16,749
Sorghum for grain	39,934
Sorghum for silage	24,833
Cotton lint and cotton seed	107,919
Soybeans for beans	41,837
Peanuts for nuts	57,266
Alfalfa seed	3,629
All hay	195,360
All other hay	2,200
Vegetables (watermelon, spinach, snap beans)	3,062
Peaches	1,093
Pecans	6,675
Government Payments	84,100
Farm Rental Received	54,492
TOTAL	1,067,433

Agricultural, Forestry and Fishery Services

Output is defined on an activity basis and includes (1) cotton ginning, fruit picking, crop dusting, custom work and other agricultural services, (2) poultry hatching, (3) animal breeding, (4) forestry sevices and operation of fish hatcheries. The estimated values of the activities that took place in Oklahoma are:

Components	Value ($1,000)
Cotton ginning	14,292
Machine hire and custom work	97,832
Chicks hatched	
Broiler type	8,202
Egg type	520
Turkey poults hatching	937
TOTAL	121,783

In 1977 there were 436,000 bales of cotton at $32.78 cost per bale. The custom work in general is assumed equal to the values of machine hire and custom work. The value is estimated on the basis of the values of 1974 (112) and 1978 Census of Agriculture (113). The values of the chicks hatched estimated on the basis of number of chicks hatched and the cost per 100 hatched. There were 29,294,000 broiler type at $28.00 per 100 and 1,666,000 egg type at the cost of $31.20 per 100. Oklahoma turkey poults hatched in 1977 were 1,300,000. To estimate the value the price at national average of 0.721 per bird hatched is used. Other agricultural, forestry and fishery services are not available for consideration.

Mining Except Fuels Sector

Non-energy mining industries are defined on an establishment basis which include extraction of solid minerals occurring naturally. That is, each industry includes the value of shipments and receipts from all economic activities, both primary and secondary performed by the establishments. The output of the non-energy mining sector specified by the list of industries mentioned below are based on the values of receipts plus the value of minerals used in the non-energy mining sector. The state values of production for the four industries comprising the mining sector are as follows:

I/O	Industry Title	Value ($1,000)
5.	Iron and ferroalloy ores mining	0
6.	Nonferrous metal ores mining	6,959
7.	Stone and clay mining and quarrying	144,174
8.	Chemical and fertilizer mineral mining	11,507
	TOTAL	162,640

Estimates concerning the value of production for the non-energy mining industries are based largely on the data from 1977 Census of Mineral Industries (117) supplemented by the U.S. Bureau of Mines, Minerals Yearbook 1981 (129). The census source provides data on total receipts for each three or four SIC digit mining industry; these are subsequently aggregated to the desired classification defined for the state input-output study.

Construction Sector

Output of new construction and maintenance and repair construction, reflect the value created by erecting and maintaining structures and other facilities. Output of new construction is defined on an activity basis and measures the value put-in-place of private and public original erections, additions and alternations which increase or alter the stock of facilities (90).

New construction includes building and non-building facilities. It also includes the value of materials used in residential construction performed by households on a do-it-yourself basis. Equipment that is an integral part of the facility and essentials for its general use is included in the value of construction. Construction covers the value of work of construction contractors, operative builders and establishments performing oil and gas field services that are performed in the mining industries.

Maintenance and repair construction includes the value created by any economic sector in maintaining or restoring the existing stock of facilities (90). The cost of which are charged to current expense. It also includes an estimated value of materials used in residential maintenance performed by households on do-it-yourself basis (90). Total value of output includes the maintenance by government agencies or non-construction firms with their own employees. The output values for construction industries in Oklahoma are as follows:

I/O	Industry Title	Value ($1,000)
9.	New construction	1,944,003
10.	Maintenance and repair construction	422,951
	TOTAL	2,366,954

The values of output for the construction industries appear in the 1977 Census of Construction Industries (114) and U.S. Bureau of Mines, 1978 Minerals Yearbook (129).

Manufacturing Sector

Output of each industry in the manufacturing sector consisting of 52 sectors is defined as the value of production of the industries in that sector. Manufacturing outputs are based on establishment in that sector and therefore include receipts from primary and secondary activities performed by the various establishments (90).

Because the value of shipments constitutes the major portion of the value of production, as defined for an input-output industry, is generally considered a relatively good proxy of the pattern of state outputs. Minor items included in the definition of output, but excluded from the value of shipments, consist of work-in process and finished goods inventory changes. Therefore, shipments data are then grouped by input-output industry definition and aggregated in 52 industries. Each industry's output is estimated by adding the value of shipments and the value of inventory change is allocated to the various industries in proportion to the distribution of value of shipment of each industry to the total state value of shipments. Output estimates of the industries in the manufacturing sector are presented in Table XLVII. The values of shipments and inventory changes for the manufacturing sector are obtained from the 1977 Census of Manufacturing (116).

TABLE XLVII

ESTIMATED OUTPUT FOR MANUFACTURING SECTORS OKLAHOMA, 1977
($1,000)

	Input/Ouput Industries	Value of Shipments	Inventory Change	Output Value
11.	Ordnance and accessories	14,756	207	14,963
12.	Food and kindred products	1,627,200	22,820	1,650,120
13.	Tobacco manufacturers	0	0	0
14.	Broad and narrow fabrics, yarn and thread mills	38,000	533	38,533
15.	Miscellaneous textile goods and floor coverings	78,200	1,097	79,297
16.	Apparel	271,200	3,083	274,283
17.	Miscellaneous fabricated textile products	56,600	794	57,394
18.	Lumber and wood products except containers	253,300	3,552	256,852
19.	Wood containers	6,800	95	6,895
20.	Household furniture	47,000	659	47,659
21.	Other furniture and fixtures	22,700	318	23,018
22.	Paper and allied products except containers	199,500	2,798	202,298
23.	Paperboard containers and boxes	45,900	644	46,544
24.	Printing and publishing	340,000	4,768	344,768
25.	Chemical and selected chemical products	349,600	4,903	354,503
26.	Plastics and synthetic materials	3,200	14	3,214
27.	Drugs, cleaning and toilet preparations	13,000	204	13,204

TABLE XLVII (Continued)

	Input/Ouput Industries	Value of Shipments	Inventory Change	Output Value
28.	Paints and allied products	24,900	349	25,249
29.	Paving and roofing materials	60,400	847	61,247
30.	Rubber and miscellaneous plastic products	732,700	10,275	742,975
31.	Leather tanning and finishing	7,100	100	7,200
32.	Footwear and other leather products	12,300	172	12,472
33.	Glass and glass products	179,000	2,510	181,510
34.	Stone and clay products	282,500	3,962	286,462
35.	Primary iron and steel manufacturers	162,200	2,275	164,475
36.	Primary nonferrous metal manufacturers	133,100	1,867	134,967
37.	Metal containers	13,303	187	13,490
38.	Heating, plumbing and structural metal products	707,300	9,919	717,219
39.	Screw machine products and stampings	34,100	478	34,578
40.	Other fabricated metal products	253,741	3,567	257,308
41.	Engines and turbines	32,500	456	32,956
42.	Farm and garden machinery	53,500	750	54,250
43.	Construction and mining machinery	726,142	10,042	726,142
44.	Materials handling machine and equipment	31,800	446	32,246
45.	Metal working machine and equipment	15,500	257	15,757
46.	Special industry machine and equipment	110,300	1,547	111,847
47.	General industrial machine and equipment	253,000	3,548	256,548
48.	Miscellaneous machinery except electrical	111,064	1,558	112,622

TABLE XLVII (Continued)

	Input/Ouput Industries	Value of Shipments	Inventory Change	Output Value
49.	Office, computing and accounting machines	213,736	2,997	216,733
50.	Service industry machines	93,600	1,313	94,913
51.	Electrical, industrial equipment and apparatus	59,400	833	60,233
52.	Household appliances	5,598	78	5,676
53.	Electrical lighting and wiring equipment	16,500	231	16,731
54.	Radio, TV and communication equipment	647,000	9,073	656,073
55.	Electronic components and accessories	48,200	676	68,876
56.	Miscellaneous electrical machinery and supplies	17,602	247	17,849
57.	Motor vehicles and equipments	263,800	3,699	267,499
58.	Aircraft and parts	248,200	3,480	251,680
59.	Other transportation equipment	61,600	864	62,464
60.	Scientific and controlling instruments	46,200	648	46,848
61.	Optical, ophthalmic, and photo equipment	67,200	942	68,142
62.	Miscellaneous manufacturing	76,600	1,074	77,674
	TOTAL	9,158,700	127,756	9,286,456

General Service Sector

The general services are divided into four major sectors namely (1) transportation, communication and non-energy utilities, (2) wholesale and retail trade, (3) finance, insurance and real estate, and (4) services. These broad sectors are given jointly because same techniques are used to estimate each sector's output. No source indicates the output directly for the state. Therefore, it needs to be estimated from the national data. For the estimates, it is assumed that the ratio of output between Oklahoma and the United States is the same as the ratio of employment between Oklahoma and the United States. In other words it is assumed that the labor productivity of Oklahoma is equal to that of the nation. By this method, output is estimated for each sector as shown below.

Transportation, Communication and Utilities Sector

The output of this sector is defined on a modified activity basis. It is the value of receipts received by all private establishments.

I/O	Industries	Value ($1,000)
63.	Transportation and warehousing	1,672,775
64.	Communications except radio and TV	437,883
65.	Radio and TV broadcasting	75,317
66.	Water supply and sanitary services	72,826
	TOTAL	2,258,801

Wholesale and Retail Trade Sector

The output of wholesale and retail trade is defined on a gross margins basis. It reflects a modified activity definition. Its major receipts are gross margins (operating expenses plus profits) from the reselling activities of wholesale and retail trade establishments. It is the value of services performed in handling goods. The output estimate is obtained from 1977 Census of Wholesale Trade (120) and 1977 Census of Retail Trade (118).

I/O	Industry	Value ($1,000)
67.	Wholesale and retail trade	3,573,348

Finance, Insurance and Real Estate Sector

The output is defined as the value of receipts received for services in this sector. The output estimates for the industries included in this broad sector are as follows:

I/O	Industries	Value ($1,000)
68.	Finance and insurance	1,164,370
69.	Real estate and rental	2,888,657
	TOTAL	4,053,027

Service Sector

The output is defined on an activity basis as the amount paid to the industries of this broad sector for their service activities. The values of output of the industries are given below:

I/O	Industries	Value ($1,000)
70.	Hotels and lodging, personal and repair services (except auto)	529,759
71.	Business services	571,254
72.	Eating and drinking places	687,210
73.	Automobile repair and services	245,887
74.	Amusements	117,356
75.	Health, education and social services and non-profit organizations	1,995,097
	TOTAL	4,146,563

The output for the industries in the general services are estimated by using the information in the 1977 Census of Service Sector (117) and 1977 Census of Retail Trade (118).

I/O	Industry
76.	Federal government enterprises

This industry includes all the activities of those federal government agencies, with separate accounting records, that cover over half of their current operating cost by the sale of goods and services to the general public. State outputs of federal governmnent enterprises includes three major components: (1) post office services, (2) the receipts of post exchanges, and (3) the value of services provided by other government enterprises (90). No source indicates the state output directly. It is, therefore, estimated from national data. To construct state estimates of output of federal goverment enterprises, it is assumed that the ratio of output between Oklahoma and the United States is the same to the ratio of total government personnel consisting both the active duty military personnel and civilians between Oklahoma and the United States. By this method, output is estimated at $257,913,000. The main source of national output is the Bureau of Economic Analysis Summary Input-Output Tables (110). Government personnel statistics are obtained from Selected Manpower Statistics (123) and 1979 Statistical Abstract of the United States (121).

<u>I/O</u>	<u>Industry</u>
77.	State and local government enterprises

Output is defined as revenue received. This industry holds the activities of the state and local government agencies, with separate accounting records, that cover over half of their current operating costs by the sale of goods and services to the general public. State and local government enterprises includes: (1) gas and electric utilities, (2) water supply facilities, (3) transit facilities (4) liquor stores, (5) water transportation and terminals, (6) air transportation facilities, (7) highway toll facilities and such activities as (8) sewers and sewage disposal, (9) low-cost housing and urban renewal, and (10) some miscellaneous activities such as offstreet parking and city markets (90). State output for the state and local government enterprises is estimated on the basis of ratio of Oklahoma revenue to U.S. revenue for the items mentioned above multiplied by the industry output for the United States. The output of the Oklahoma state and local government enterprises is estimated at $191,494,000. Industry output for the United States is obtained by using the information in the Bureau of Economic Analysis Summary Input-Output Tables (104). The U.S. and Oklahoma revenues for the included activities are obtained from the 1977 Census of Governments (109).

APPENDIX B

INPUT-OUTPUT COEFFICIENT MATRICES FOR

OKLAHOMA AND REST OF U.S., 1977

TABLE XLVIII

OKLAHOMA DIRECT COEFFICIENT MATRIX, 1977

AOK1	1	2	3	4	5	6	7	8	9
1	0.21294	0.01531	0.00000	0.06256	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.34997	0.03114	0.00000	0.02153	0.00000	0.00000	0.00000	0.00000	0.00124
3	0.00000	0.00000	0.00346	0.00221	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.02939	0.02437	0.02644	0.03238	0.00000	0.00000	0.00000	0.00000	0.00057
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.02149	0.00000	0.00000	0.00000
7	0.00002	0.00172	0.00000	0.00037	0.00000	0.00028	0.02037	0.00831	0.00726
8	0.00000	0.00104	0.00000	0.00000	0.00000	0.00000	0.00000	0.01893	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00476	0.00560	0.00000	0.01509	0.00000	0.00621	0.00613	0.00554	0.00019
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001
12	0.12951	0.00001	0.02381	0.00801	0.00000	0.00000	0.00000	0.00039	0.00016
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00002	0.00000	0.00000	0.00000	0.00004	0.00000	0.00006	0.00000
15	0.00021	0.00095	0.02234	0.00865	0.00000	0.00000	0.00000	0.00000	0.00274
16	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00038	0.00000	0.00004
17	0.00000	0.00017	0.00513	0.00171	0.00000	0.00000	0.00000	0.00000	0.00001
18	0.00010	0.00005	0.00000	0.00000	0.00000	0.00287	0.00000	0.00031	0.04166
19	0.00001	0.00144	0.00000	0.00257	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00019
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00060
22	0.00103	0.00024	0.00000	0.00078	0.00000	0.00000	0.00257	0.00098	0.00137
23	0.00001	0.00002	0.00000	0.01244	0.00000	0.00000	0.00000	0.00000	0.00001
24	0.00013	0.00008	0.00143	0.00196	0.00000	0.00000	0.00031	0.00000	0.00010
25	0.00165	0.05581	0.01140	0.02822	0.00000	0.02524	0.01038	0.00929	0.00209
26	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00000	0.00000	0.00190	0.00000	0.00000	0.00000	0.00000	0.00000	0.00163
29	0.00038	0.00156	0.00230	0.00184	0.00000	0.00085	0.00263	0.00092	0.00114
30	0.00224	0.00405	0.00172	0.00110	0.00000	0.01553	0.00942	0.00185	0.00834
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00006	0.00000	0.00000	0.00011	0.00000	0.00000	0.00000	0.00000	0.00000
33	0.00006	0.00000	0.00000	0.00037	0.00000	0.00028	0.00022	0.00000	0.00087
34	0.00000	0.00017	0.00000	0.00368	0.00000	0.00734	0.00066	0.00046	0.07015
35	0.00005	0.00003	0.00000	0.00000	0.00000	0.00683	0.00713	0.00372	0.00749
36	0.00000	0.00000	0.00000	0.00000	0.00000	0.00049	0.00129	0.00016	0.00639
37	0.00000	0.00000	0.00330	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.00011	0.00008	0.00000	0.00000	0.00000	0.00000	0.00219	0.00185	0.10102
39	0.00005	0.00000	0.00000	0.00000	0.00000	0.00035	0.00031	0.00057	0.00007
40	0.00087	0.00091	0.01918	0.00829	0.00000	0.00636	0.00683	0.00080	0.02314
41	0.00000	0.00000	0.00365	0.00210	0.00000	0.00117	0.00445	0.00147	0.00000
42	0.00167	0.00232	0.00000	0.00234	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.02315	0.04578	0.01477	0.00358
44	0.00000	0.00000	0.00000	0.00000	0.00000	0.00126	0.00588	0.00148	0.00274
45	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000
46	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
47	0.00013	0.00027	0.01035	0.00000	0.00000	0.00085	0.00591	0.00231	0.00325
48	0.00019	0.00014	0.00000	0.00000	0.00000	0.00395	0.00088	0.00000	0.00008
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00448
51	0.00000	0.00000	0.00000	0.00000	0.00000	0.00045	0.00061	0.00037	0.00238
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00006
53	0.00001	0.00000	0.00023	0.00000	0.00000	0.00006	0.00004	0.00000	0.00251
54	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00058
55	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00004	0.00009	0.00000	0.00041	0.00000	0.00011	0.00004	0.00000	0.00006
57	0.00008	0.00006	0.00000	0.00085	0.00000	0.00013	0.00106	0.00021	0.00005
58	0.00000	0.00000	0.00000	0.00147	0.00000	0.00000	0.00000	0.00000	0.00000
59	0.00000	0.00000	0.01095	0.00030	0.00000	0.00034	0.00000	0.00019	0.00000
60	0.00000	0.00000	0.00114	0.00000	0.00000	0.00008	0.00000	0.00000	0.00075
61	0.00001	0.00000	0.00000	0.00021	0.00000	0.00000	0.00000	0.00000	0.00003
62	0.00002	0.00001	0.00094	0.00045	0.00000	0.00046	0.00027	0.00057	0.00030
63	0.01393	0.00876	0.01811	0.03551	0.00000	0.01045	0.01051	0.00831	0.02056
64	0.00258	0.00178	0.00201	0.00644	0.00000	0.00056	0.00110	0.00046	0.00215
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00055	0.00028	0.00000	0.00074	0.00000	0.00198	0.00241	0.00323	0.00006
67	0.02475	0.02076	0.02616	0.02999	0.00000	0.01186	0.02212	0.00600	0.05027
68	0.01294	0.00814	0.01064	0.01270	0.00000	0.01129	0.01161	0.00831	0.00434
69	0.02325	0.09833	0.00862	0.03238	0.00000	0.01807	0.03724	0.02307	0.00474
70	0.00002	0.00001	0.00316	0.00626	0.00000	0.00141	0.00197	0.00046	0.00018
71	0.00414	0.00935	0.02472	0.07636	0.00000	0.01666	0.03395	0.01800	0.05083
72	0.00038	0.00024	0.00201	0.00754	0.00000	0.00131	0.00101	0.00092	0.00312
73	0.00268	0.00203	0.01092	0.01914	0.00000	0.00226	0.00964	0.00277	0.00329
74	0.00001	0.00000	0.00000	0.00011	0.00000	0.00000	0.00000	0.00000	0.00004
75	0.00077	0.00003	0.00009	0.00063	0.00000	0.00021	0.00020	0.00007	0.00006
76	0.00013	0.00008	0.00029	0.00147	0.00000	0.00056	0.00044	0.00138	0.00020
77	0.00000	0.00000	0.00027	0.00035	0.00000	0.00053	0.00103	0.00043	0.00005
78	0.01019	0.08965	0.08877	0.08185	0.00000	0.07285	0.03207	0.08438	0.02106
79	0.00017	0.00442	0.02027	0.03057	0.00000	0.01323	0.00130	0.00000	0.00711
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
81	0.00332	0.00424	0.01919	0.02895	0.00000	0.07054	0.01494	0.02964	0.00323
TI	0.83558	0.39576	0.38490	0.59299	0.00000	0.35995	0.31728	0.26294	0.47062
VA	0.16442	0.60424	0.61510	0.40701	1.00000	0.64005	0.68272	0.73706	0.52938
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK2	10	11	12	13	14	15	16	17	18
1	0.00000	0.00000	0.18225	0.00000	0.00232	0.00542	0.00000	0.00000	0.00000
2	0.00038	0.00010	0.10576	0.00000	0.06228	0.00343	0.00083	0.00000	0.00000
3	0.00000	0.00000	0.00412	0.00000	0.00000	0.00000	0.00244	0.00000	0.05837
4	0.00020	0.00000	0.00000	0.00000	0.00000	0.00000	0.00019	0.00000	0.00051
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.01888	0.00000	0.00006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00005	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00070	0.00464	0.00175	0.00000	0.00222	0.00133	0.00090	0.00072	0.00274
11	0.00000	0.00420	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00050	0.00099	0.19057	0.00000	0.00270	0.00113	0.00053	0.00217	0.00013
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00000	0.00000	0.02534	0.02319	0.03239	0.02887	0.00000
15	0.00198	0.00009	0.00008	0.00000	0.00428	0.05980	0.00335	0.07411	0.00042
16	0.00013	0.00101	0.00012	0.00000	0.00033	0.00744	0.21022	0.00422	0.00025
17	0.00054	0.00055	0.00019	0.00000	0.00002	0.00253	0.00849	0.01397	0.00013
18	0.03038	0.00137	0.00010	0.00000	0.00191	0.00075	0.00063	0.00155	0.16086
19	0.00000	0.00185	0.00026	0.00000	0.00000	0.00000	0.00000	0.00000	0.00003
20	0.00016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001
21	0.00047	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00290	0.00036	0.00572	0.00000	0.00068	0.00254	0.00239	0.00573	0.00068
23	0.00000	0.00104	0.00710	0.00000	0.00196	0.00293	0.00428	0.00341	0.00095
24	0.00037	0.00041	0.00365	0.00000	0.00016	0.00024	0.00097	0.00129	0.00011
25	0.00442	0.00372	0.00306	0.00000	0.01981	0.02070	0.00461	0.00100	0.00641
26	0.00000	0.00003	0.00000	0.00000	0.00144	0.00162	0.00031	0.00006	0.00003
27	0.00000	0.00002	0.00011	0.00000	0.00011	0.00004	0.00008	0.00000	0.00000
28	0.02155	0.00023	0.00000	0.00000	0.00012	0.00043	0.00000	0.00000	0.00141
29	0.00442	0.00029	0.00021	0.00000	0.00019	0.00022	0.00025	0.00012	0.00105
30	0.01964	0.00435	0.00941	0.00000	0.00404	0.02556	0.00476	0.02210	0.00534
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00222	0.00189	0.00000
32	0.00001	0.00002	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00002
33	0.00234	0.00019	0.01258	0.00000	0.00232	0.00288	0.00000	0.00000	0.00130
34	0.06635	0.00145	0.00057	0.00000	0.00069	0.00077	0.00056	0.00048	0.00744
35	0.00483	0.01625	0.00014	0.00000	0.00008	0.00015	0.00011	0.00010	0.00109
36	0.00221	0.01398	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00015
37	0.00000	0.00000	0.00484	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.06389	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00136
39	0.00022	0.00138	0.00033	0.00000	0.00000	0.00000	0.00000	0.00000	0.00057
40	0.01861	0.00837	0.00135	0.00000	0.00062	0.00000	0.00080	0.00000	0.02604
41	0.00000	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00594	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00018
44	0.00807	0.00000	0.00000	0.00000	0.00066	0.00028	0.00014	0.00000	0.00074
45	0.00001	0.00033	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002
46	0.00000	0.00000	0.00063	0.00000	0.00661	0.00553	0.00151	0.00012	0.00246
47	0.00278	0.00532	0.00055	0.00000	0.00025	0.00221	0.00046	0.00000	0.00151
48	0.00044	0.00396	0.00031	0.00000	0.00110	0.00089	0.00059	0.00036	0.00128
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.01816	0.00000	0.00012	0.00000	0.00005	0.00000	0.00000	0.00000	0.00010
51	0.00298	0.00061	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00014
52	0.00048	0.00000	0.00000	0.00000	0.00000	0.00000	0.00004	0.00005	0.00000
53	0.00658	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00007
54	0.00258	0.01798	0.00001	0.00000	0.00003	0.00000	0.00003	0.00000	0.00003
55	0.00000	0.00495	0.00000	0.00000	0.00008	0.00000	0.00000	0.00000	0.00000
56	0.00014	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00004
57	0.00017	0.00040	0.00002	0.00000	0.00001	0.00000	0.00001	0.00000	0.00029
58	0.00000	0.06409	0.00001	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00004
60	0.00163	0.00137	0.00002	0.00000	0.00012	0.00000	0.00000	0.00000	0.00009
61	0.00003	0.00005	0.00001	0.00000	0.00023	0.00038	0.00005	0.00007	0.00003
62	0.00172	0.00016	0.00002	0.00000	0.00003	0.00009	0.00581	0.00148	0.00018
63	0.04232	0.01189	0.02332	0.00000	0.01313	0.02158	0.01631	0.01739	0.02419
64	0.00752	0.00667	0.00147	0.00000	0.00210	0.00354	0.00528	0.00374	0.00146
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00020	0.00077	0.00052	0.00000	0.00081	0.00077	0.00053	0.00036	0.00056
67	0.10218	0.01131	0.03114	0.00000	0.02550	0.03021	0.03941	0.02814	0.02570
68	0.01308	0.00445	0.00369	0.00000	0.00254	0.00266	0.00775	0.00483	0.00537
69	0.01645	0.00812	0.00448	0.00000	0.00551	0.01283	0.01415	0.01497	0.00568
70	0.00064	0.00406	0.00222	0.00000	0.00154	0.00476	0.00497	0.00495	0.00164
71	0.03129	0.04292	0.02698	0.00000	0.01285	0.02003	0.02805	0.01461	0.01222
72	0.01089	0.02223	0.00139	0.00000	0.00250	0.00177	0.00432	0.00217	0.00189
73	0.00831	0.00261	0.00258	0.00000	0.00081	0.00122	0.00148	0.00109	0.00680
74	0.00013	0.00028	0.00005	0.00000	0.00002	0.00000	0.00011	0.00014	0.00006
75	0.00020	0.00029	0.00013	0.00000	0.00020	0.00008	0.00036	0.00049	0.00015
76	0.00076	0.00280	0.00068	0.00000	0.00075	0.00089	0.00300	0.00121	0.00041
77	0.00017	0.00000	0.00012	0.00000	0.00003	0.00000	0.00006	0.00000	0.00029
78	0.02692	0.02120	0.00162	0.00000	0.00811	0.00223	0.00134	0.00223	0.00934
79	0.00195	0.01815	0.00158	0.00000	0.00205	0.00643	0.00022	0.00046	0.00458
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
81	0.00419	0.04592	0.00629	0.00000	0.02097	0.00870	0.00614	0.00355	0.01349
TI	0.58499	0.37009	0.64434	0.00000	0.24227	0.29018	0.42345	0.26420	0.39843
VA	0.41501	0.62991	0.35566	1.00000	0.75773	0.70982	0.57655	0.73580	0.60157
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK3	19	20	21	22	23	24	25	26	27
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00032
2	0.00000	0.00000	0.00000	0.00102	0.00000	0.00006	0.00101	0.00000	0.00168
3	0.00000	0.00000	0.00000	0.00012	0.00000	0.00000	0.00012	0.00000	0.00012
4	0.00000	0.00048	0.00000	0.00013	0.00007	0.00014	0.00013	0.00010	0.00023
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00004	0.00000	0.00000	0.00097	0.00003	0.00000
7	0.00000	0.00000	0.00000	0.00328	0.00000	0.00000	0.00328	0.00000	0.00052
8	0.00000	0.00000	0.00000	0.00031	0.00000	0.00000	0.00971	0.00008	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00082	0.00181	0.00179	0.00766	0.00493	0.00306	0.00451	0.00662	0.00515
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00000	0.00439	0.00025	0.01146	0.00013	0.00044	0.00593	0.00270	0.01520
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00601	0.00044	0.00079	0.00000	0.00004	0.00000	0.00019	0.00000
15	0.00000	0.01608	0.01185	0.00373	0.00000	0.00076	0.00000	0.00000	0.00003
16	0.00000	0.00216	0.00247	0.00022	0.00026	0.00033	0.00004	0.00013	0.00006
17	0.00000	0.00102	0.00266	0.00000	0.00000	0.00003	0.00014	0.00000	0.00018
18	0.14453	0.09461	0.03742	0.04759	0.00005	0.00000	0.00072	0.00020	0.00011
19	0.00285	0.00011	0.00009	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00155	0.00014	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00263	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00000	0.00091	0.00024	0.11533	0.24599	0.08612	0.00290	0.01552	0.00495
23	0.00000	0.00596	0.00315	0.00547	0.00611	0.00078	0.00099	0.00320	0.00862
24	0.00000	0.00061	0.00074	0.00056	0.00027	0.09257	0.00027	0.00028	0.00283
25	0.00000	0.00113	0.00159	0.02567	0.01449	0.01165	0.11395	0.23336	0.05906
26	0.00000	0.00000	0.00001	0.00029	0.00022	0.00000	0.00012	0.00073	0.00002
27	0.00000	0.00000	0.00000	0.00004	0.00000	0.00000	0.00002	0.00015	0.00201
28	0.00000	0.00388	0.00249	0.00014	0.00000	0.00013	0.00038	0.00046	0.00044
29	0.00000	0.00029	0.00030	0.00085	0.00052	0.00016	0.00058	0.00054	0.00055
30	0.00000	0.05393	0.04456	0.01811	0.00134	0.00598	0.00428	0.01379	0.04772
31	0.00000	0.00062	0.00023	0.00000	0.00000	0.00003	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00000	0.00001	0.00000	0.00001	0.00002	0.00000	0.00001
33	0.00000	0.00466	0.00477	0.00003	0.00000	0.00002	0.00019	0.00035	0.00149
34	0.00000	0.00628	0.00373	0.00236	0.00060	0.00090	0.00131	0.00030	0.00068
35	0.00682	0.00527	0.02201	0.00011	0.00130	0.00010	0.00090	0.00007	0.00001
36	0.00000	0.00230	0.00237	0.00031	0.00052	0.00073	0.00292	0.00041	0.00020
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00087	0.00019	0.00373
38	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
39	0.00014	0.00109	0.00243	0.00000	0.00000	0.00000	0.00001	0.00000	0.00073
40	0.00071	0.04854	0.02944	0.00486	0.00110	0.00106	0.00107	0.00077	0.00477
41	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
44	0.00000	0.00000	0.00000	0.00005	0.00000	0.00006	0.00000	0.00000	0.00000
45	0.00000	0.00000	0.00004	0.00000	0.00009	0.00001	0.00000	0.00001	0.00001
46	0.00082	0.00124	0.00000	0.00387	0.00470	0.00286	0.00697	0.00633	0.00000
47	0.00000	0.00010	0.00164	0.00095	0.00030	0.00006	0.00423	0.00193	0.00091
48	0.00082	0.00095	0.00075	0.00090	0.00119	0.00032	0.00044	0.00084	0.00036
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00023	0.00000	0.00000
51	0.00000	0.00000	0.00065	0.00000	0.00000	0.00000	0.00010	0.00000	0.00000
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
53	0.00000	0.00010	0.00003	0.00002	0.00000	0.00000	0.00001	0.00001	0.00001
54	0.00000	0.00000	0.00000	0.00003	0.00000	0.00006	0.00003	0.00000	0.00006
55	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
57	0.00000	0.00002	0.00000	0.00000	0.00002	0.00001	0.00000	0.00000	0.00001
58	0.00000	0.00000	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
60	0.00000	0.00011	0.00000	0.00023	0.00000	0.00001	0.00015	0.00017	0.00034
61	0.00000	0.00022	0.00000	0.00003	0.00004	0.00230	0.00004	0.00003	0.00006
62	0.00000	0.00070	0.00049	0.00006	0.00028	0.00062	0.00002	0.00002	0.00020
63	0.02128	0.02387	0.02399	0.03665	0.04447	0.02831	0.02599	0.02012	0.02266
64	0.00164	0.00314	0.00224	0.00177	0.00388	0.00983	0.00186	0.00287	0.00411
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00000	0.00048	0.00060	0.00164	0.00052	0.00038	0.00209	0.00114	0.00042
67	0.02455	0.03795	0.03726	0.02845	0.01948	0.01857	0.01154	0.01626	0.02195
68	0.00736	0.00656	0.00730	0.00346	0.00313	0.00728	0.00358	0.00504	0.00563
69	0.00409	0.01122	0.01446	0.01298	0.01291	0.03988	0.01270	0.01092	0.03004
70	0.00818	0.00181	0.00358	0.00376	0.00567	0.00842	0.00188	0.00267	0.01007
71	0.00655	0.02530	0.01699	0.01982	0.01970	0.04760	0.02202	0.02580	0.15407
72	0.00164	0.00385	0.00448	0.00279	0.00298	0.00973	0.00399	0.00371	0.01547
73	0.00164	0.00266	0.00522	0.00118	0.00216	0.00338	0.00091	0.00119	0.00142
74	0.00000	0.00005	0.00009	0.00003	0.00004	0.00019	0.00006	0.00003	0.00026
75	0.00012	0.00030	0.00036	0.00010	0.00014	0.00053	0.00009	0.00015	0.00055
76	0.00082	0.00095	0.00104	0.00069	0.00082	0.01127	0.00055	0.00035	0.00152
77	0.00000	0.00009	0.00000	0.00104	0.00007	0.00009	0.00085	0.00051	0.00012
78	0.02344	0.00197	0.00376	0.09823	0.01092	0.00111	0.07965	0.01930	0.01850
79	0.00425	0.00055	0.00344	0.03679	0.00949	0.00089	0.04384	0.00466	0.00163
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
81	0.01362	0.00625	0.00420	0.04163	0.01506	0.00894	0.04769	0.01571	0.00573
TI	0.27669	0.39413	0.31041	0.54770	0.43596	0.40781	0.42885	0.41994	0.45753
VA	0.72331	0.60587	0.68959	0.45230	0.56404	0.59219	0.57115	0.58006	0.54247
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK4	28	29	30	31	32	33	34	35	36
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00567	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000
3	0.00224	0.00000	0.00000	0.00000	0.00000	0.00000	0.00006	0.00000	0.00000
4	0.00000	0.00000	0.00020	0.00000	0.00000	0.00076	0.00023	0.00011	0.00040
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00048	0.00000	0.00001	0.00000	0.00000	0.00000	0.00058	0.00018	0.01566
7	0.00179	0.00109	0.00050	0.00000	0.00000	0.00844	0.05346	0.00254	0.00010
8	0.00000	0.00000	0.00082	0.00149	0.00000	0.00024	0.00245	0.00095	0.00001
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00209	0.00897	0.00364	0.00272	0.00129	0.00660	0.00608	0.01097	0.00295
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.02051	0.00070	0.00021	0.45484	0.00234	0.00009	0.00065	0.00015	0.00015
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00157	0.00000	0.00419	0.00000	0.00036	0.00000	0.00008
15	0.00000	0.00000	0.01701	0.00000	0.03932	0.00000	0.00024	0.00000	0.00025
16	0.00000	0.00000	0.00035	0.00000	0.00197	0.00038	0.00007	0.00021	0.00007
17	0.00000	0.00000	0.00007	0.00000	0.00127	0.00023	0.00000	0.00005	0.00011
18	0.00000	0.00000	0.00198	0.00000	0.00731	0.00783	0.00479	0.00269	0.00244
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00126	0.00011	0.00018	0.00038
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00013	0.00000
22	0.00103	0.00087	0.00452	0.00036	0.00593	0.00213	0.00865	0.00030	0.00050
23	0.00192	0.00068	0.00415	0.00024	0.00530	0.01684	0.00148	0.00032	0.00051
24	0.00477	0.00000	0.00032	0.00000	0.00057	0.00123	0.00024	0.00056	0.00023
25	0.15990	0.01336	0.03302	0.06575	0.00677	0.02248	0.01988	0.01574	0.01137
26	0.00201	0.00000	0.00256	0.00000	0.00002	0.00000	0.00009	0.00000	0.00015
27	0.00007	0.00006	0.00001	0.00159	0.00009	0.00000	0.00002	0.00000	0.00000
28	0.00347	0.00000	0.00036	0.00000	0.00031	0.00088	0.00063	0.00018	0.00046
29	0.00104	0.00326	0.00020	0.00068	0.00016	0.00032	0.00072	0.00040	0.00037
30	0.00224	0.00082	0.03479	0.00000	0.07799	0.03981	0.00509	0.00097	0.00621
31	0.00000	0.00000	0.00001	0.03133	0.06075	0.00000	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00001	0.00000	0.00324	0.00000	0.00000	0.00001	0.00000
33	0.00060	0.00000	0.00270	0.00000	0.00000	0.05938	0.00076	0.00006	0.00027
34	0.00433	0.00163	0.00185	0.00477	0.00032	0.01590	0.11018	0.00732	0.00233
35	0.00036	0.00007	0.00184	0.00000	0.00022	0.00090	0.00189	0.05922	0.00216
36	0.00505	0.00047	0.00025	0.00000	0.00134	0.00078	0.00091	0.00978	0.12910
37	0.00751	0.00077	0.00000	0.00000	0.00000	0.00000	0.00002	0.00006	0.00000
38	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00008	0.00127	0.00000
39	0.00003	0.00000	0.00095	0.00000	0.00113	0.00044	0.00005	0.00106	0.00025
40	0.00259	0.00071	0.00679	0.00000	0.01257	0.00047	0.00883	0.00879	0.00497
41	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00007	0.00004	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00202	0.00000	0.00000
44	0.00000	0.00000	0.00005	0.00000	0.00072	0.00000	0.00010	0.00051	0.00030
45	0.00000	0.00000	0.00013	0.00000	0.00000	0.00011	0.00001	0.00029	0.00029
46	0.00000	0.00000	0.00297	0.00000	0.00580	0.00887	0.00030	0.00122	0.00000
47	0.00000	0.00082	0.00065	0.00000	0.00000	0.00087	0.00091	0.01886	0.00596
48	0.00015	0.00000	0.00190	0.00068	0.00129	0.00325	0.00152	0.00490	0.00243
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00071	0.00000
50	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00004	0.00000
51	0.00000	0.00000	0.00000	0.00000	0.00000	0.00030	0.00036	0.00306	0.00118
52	0.00000	0.00000	0.00000	0.00000	0.00005	0.00001	0.00000	0.00000	0.00000
53	0.00000	0.00000	0.00014	0.00000	0.00000	0.00011	0.00027	0.00048	0.00012
54	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00004	0.00002	0.00002
55	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000
57	0.00000	0.00000	0.00014	0.00000	0.00000	0.00000	0.00004	0.00000	0.00000
58	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00023	0.00000
60	0.00008	0.00008	0.00025	0.00000	0.00000	0.00052	0.00010	0.00039	0.00005
61	0.00008	0.00000	0.00006	0.00000	0.00009	0.00006	0.00009	0.00007	0.00003
62	0.00049	0.00000	0.00031	0.00028	0.00442	0.00035	0.00051	0.00017	0.00009
63	0.02820	0.03451	0.02486	0.02861	0.01708	0.03732	0.07399	0.04818	0.01885
64	0.00462	0.00109	0.00300	0.00136	0.00403	0.00281	0.00308	0.00198	0.00159
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00030	0.00082	0.00002	0.00068	0.00032	0.00270	0.00205	0.00214	0.00159
67	0.02104	0.00380	0.01560	0.04360	0.03110	0.02315	0.01680	0.02656	0.02433
68	0.00388	0.00299	0.00414	0.00613	0.00596	0.00552	0.00658	0.00454	0.00452
69	0.02506	0.00516	0.00854	0.00817	0.01482	0.01385	0.01281	0.00178	0.00427
70	0.00731	0.00027	0.00444	0.00068	0.00209	0.00162	0.00179	0.00237	0.00114
71	0.02730	0.01141	0.02366	0.08038	0.03400	0.02509	0.02106	0.01670	0.01477
72	0.00673	0.00109	0.00369	0.00272	0.00483	0.00400	0.00449	0.00268	0.00156
73	0.00179	0.00027	0.00132	0.00681	0.00145	0.00422	0.00426	0.00100	0.00109
74	0.00009	0.00000	0.00003	0.00000	0.00009	0.00012	0.00004	0.00005	0.00001
75	0.00016	0.00004	0.00028	0.00010	0.00029	0.00023	0.00016	0.00016	0.00011
76	0.00134	0.00027	0.00065	0.00136	0.00403	0.00097	0.00087	0.00068	0.00040
77	0.00000	0.00026	0.00005	0.00000	0.00000	0.00010	0.00018	0.00117	0.00026
78	0.00379	0.03580	0.00484	0.03190	0.00558	0.01592	0.01307	0.01240	0.00204
79	0.00158	0.02665	0.00288	0.01119	0.00336	0.02394	0.02323	0.00751	0.00435
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01635	0.00091	0.00021
81	0.00590	0.01156	0.01645	0.01055	0.01717	0.03482	0.03043	0.04423	0.06407
TI	0.36959	0.17035	0.24180	0.79897	0.39297	0.39822	0.46618	0.33029	0.33711
VA	0.63041	0.82965	0.75820	0.20103	0.60703	0.60178	0.53382	0.66971	0.66289
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK5	37	38	39	40	41	42	43	44	45
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00005	0.00000	0.00000
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00043	0.00053	0.00030	0.00023	0.00009	0.00017	0.00005	0.00000	0.00000
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00003	0.00000	0.00023	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00161	0.00155	0.00256	0.00261	0.00140	0.00177	0.00383	0.00154	0.00294
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00000	0.00020	0.00017	0.00017	0.00016	0.00151	0.00018	0.00016	0.00038
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	0.00000	0.00000	0.00000	0.00041	0.00000	0.00000	0.00000	0.00000	0.00000
16	0.00009	0.00023	0.00026	0.00026	0.00016	0.00022	0.00014	0.00000	0.00032
17	0.00023	0.00012	0.00060	0.00009	0.00000	0.00000	0.00000	0.00000	0.00000
18	0.00094	0.00143	0.00130	0.00429	0.00000	0.00171	0.00146	0.00104	0.00070
19	0.00000	0.00013	0.00063	0.00011	0.00000	0.00039	0.00019	0.00022	0.00026
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00014	0.00000
22	0.00097	0.00085	0.00181	0.00016	0.00025	0.00013	0.00014	0.00021	0.00023
23	0.00223	0.00136	0.00159	0.00281	0.00090	0.00084	0.00000	0.00014	0.00026
24	0.02652	0.00019	0.00021	0.00023	0.00020	0.00036	0.00031	0.00027	0.00037
25	0.00171	0.00112	0.00333	0.01034	0.00055	0.00010	0.00054	0.00011	0.00161
26	0.00003	0.00000	0.00002	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00004	0.00003	0.00003	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00653	0.00250	0.00059	0.00282	0.00015	0.00118	0.00061	0.00015	0.00023
29	0.00011	0.00020	0.00020	0.00023	0.00019	0.00025	0.00022	0.00019	0.00059
30	0.00075	0.00377	0.00597	0.01948	0.00328	0.03047	0.01483	0.01694	0.00316
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
33	0.00000	0.00390	0.00054	0.00082	0.00000	0.00000	0.00000	0.00000	0.00007
34	0.00118	0.00264	0.00207	0.00458	0.00786	0.00269	0.00717	0.00154	0.00764
35	0.09358	0.05860	0.06116	0.02978	0.03403	0.04164	0.03985	0.03779	0.02593
36	0.02869	0.01905	0.01265	0.01969	0.01719	0.00273	0.00208	0.00651	0.00910
37	0.00018	0.00000	0.00019	0.00004	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.00000	0.01418	0.00000	0.00023	0.01862	0.00000	0.00518	0.00674	0.00580
39	0.00008	0.00270	0.00383	0.00223	0.00332	0.00399	0.00165	0.00139	0.00106
40	0.00808	0.02205	0.00829	0.02294	0.00859	0.00956	0.00841	0.00967	0.00452
41	0.00000	0.00001	0.00000	0.00050	0.02949	0.02059	0.01000	0.00410	0.00000
42	0.00000	0.00000	0.00009	0.00006	0.00022	0.01695	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.06341	0.00000	0.00000
44	0.00000	0.00000	0.00025	0.00000	0.00000	0.00000	0.00000	0.02117	0.00000
45	0.00021	0.00022	0.00046	0.00026	0.00038	0.00034	0.00043	0.00027	0.00231
46	0.00000	0.00000	0.00015	0.00033	0.00000	0.00000	0.00000	0.00000	0.00000
47	0.00150	0.00539	0.00069	0.00177	0.01918	0.06398	0.04987	0.05294	0.02496
48	0.00225	0.00535	0.01297	0.00657	0.03490	0.01532	0.01585	0.00905	0.02276
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.00000	0.00077	0.00000	0.00008	0.00000	0.00000	0.00000	0.00000	0.00000
51	0.00000	0.00271	0.00033	0.00104	0.00248	0.00247	0.00382	0.01082	0.00907
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
53	0.00000	0.00005	0.00009	0.00001	0.00000	0.00020	0.00000	0.00000	0.00018
54	0.00000	0.00003	0.00000	0.00003	0.00000	0.00000	0.00005	0.00000	0.00007
55	0.00000	0.00000	0.00000	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00000	0.00003	0.00003	0.00000	0.00163	0.00111	0.00018	0.00027	0.00000
57	0.00000	0.00007	0.00032	0.00001	0.00080	0.00342	0.00182	0.00000	0.00000
58	0.00000	0.00000	0.00025	0.00000	0.00000	0.00000	0.00011	0.00000	0.00000
59	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
60	0.00003	0.00067	0.00008	0.00013	0.00005	0.00010	0.00008	0.00016	0.00050
61	0.00006	0.00011	0.00006	0.00004	0.00005	0.00005	0.00003	0.00011	0.00008
62	0.00000	0.00020	0.00004	0.00021	0.00004	0.00031	0.00020	0.00008	0.00012
63	0.03806	0.01953	0.01331	0.01625	0.01011	0.01953	0.00944	0.01386	0.00653
64	0.00139	0.00307	0.00187	0.00252	0.00197	0.00320	0.00458	0.00308	0.00448
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00054	0.00043	0.00054	0.00065	0.00047	0.00042	0.00043	0.00058	0.00059
67	0.02037	0.02059	0.01593	0.01598	0.02676	0.03098	0.02534	0.02079	0.01784
68	0.00450	0.00380	0.00434	0.00546	0.00346	0.00572	0.00518	0.00366	0.00485
69	0.00890	0.01183	0.00661	0.00909	0.00281	0.00244	0.00609	0.01251	0.00756
70	0.00289	0.00377	0.00163	0.00226	0.00131	0.00219	0.00129	0.00115	0.00139
71	0.02648	0.01583	0.01317	0.01880	0.01226	0.02475	0.02076	0.00808	0.01894
72	0.00247	0.00459	0.00192	0.00304	0.00303	0.00448	0.00367	0.00558	0.00727
73	0.00118	0.00202	0.00084	0.00173	0.00346	0.00118	0.00210	0.00462	0.00103
74	0.00000	0.00004	0.00003	0.00004	0.00000	0.00005	0.00022	0.00011	0.00017
75	0.00014	0.00019	0.00025	0.00019	0.00011	0.00014	0.00013	0.00017	0.00021
76	0.00021	0.00069	0.00049	0.00075	0.00066	0.00126	0.00081	0.00115	0.00154
77	0.00000	0.00003	0.00005	0.00006	0.00009	0.00008	0.00000	0.00000	0.00000
78	0.00355	0.00113	0.03652	0.00513	0.00628	0.00359	0.00079	0.00168	0.01013
79	0.03651	0.00036	0.01416	0.00170	0.00717	0.00158	0.00087	0.00243	0.01800
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
81	0.01339	0.00240	0.06381	0.01004	0.01461	0.00427	0.00559	0.05945	0.04855
TI	0.33861	0.24361	0.29958	0.22960	0.28072	0.33041	0.32003	0.32262	0.27430
VA	0.66139	0.75639	0.70042	0.77040	0.71928	0.66959	0.67997	0.67738	0.72570
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK6	46	47	48	49	50	51	52	53	54
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	0.00007	0.00000	0.00006	0.00000	0.00000	0.00010
3	0.00000	0.00000	0.00000	0.00006	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00000	0.00006	0.00012	0.00007	0.00008	0.00013	0.00000	0.00012	0.00007
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00039	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00237	0.00219	0.00170	0.00194	0.00103	0.00255	0.00193	0.00141	0.00192
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00037	0.00030	0.00021	0.00102	0.00014	0.00049	0.00031	0.00040	0.00056
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00043	0.00029	0.00000
15	0.00000	0.00257	0.00142	0.00000	0.00000	0.00012	0.00125	0.00000	0.00000
16	0.00019	0.00021	0.00085	0.00013	0.00014	0.00033	0.00008	0.00021	0.00029
17	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00025	0.00000
18	0.00358	0.00177	0.00049	0.00020	0.00113	0.00164	0.00249	0.00151	0.00058
19	0.00019	0.00031	0.00007	0.00000	0.00055	0.00044	0.00064	0.00000	0.00038
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00562
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000
22	0.00023	0.00098	0.00026	0.00183	0.00055	0.00242	0.00064	0.00019	0.00114
23	0.00039	0.00098	0.00264	0.00142	0.00286	0.00164	0.00565	0.00509	0.00095
24	0.00038	0.00025	0.00043	0.00207	0.00017	0.00054	0.00046	0.00025	0.00334
25	0.01559	0.00007	0.00265	0.00133	0.00281	0.00484	0.00490	0.00696	0.00055
26	0.00000	0.00001	0.00000	0.00002	0.00003	0.00011	0.00019	0.00020	0.00008
27	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00029	0.00005	0.00024	0.00055	0.00077	0.00119	0.00331	0.00096	0.00018
29	0.00065	0.00059	0.00097	0.00015	0.00032	0.00045	0.00009	0.00012	0.00010
30	0.01198	0.00718	0.00533	0.02254	0.01394	0.01264	0.03812	0.02199	0.00753
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00002	0.00000	0.00000	0.00002	0.00000	0.00001	0.00000	0.00000	0.00001
33	0.00108	0.00000	0.00000	0.00015	0.00055	0.00051	0.00331	0.02022	0.00175
34	0.00281	0.00498	0.00666	0.00082	0.00333	0.00983	0.00882	0.00317	0.00069
35	0.02909	0.03599	0.02792	0.00494	0.02551	0.02070	0.02463	0.01471	0.00264
36	0.01260	0.00973	0.01610	0.00701	0.01655	0.02600	0.01630	0.01928	0.00898
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.01241	0.00658	0.00000	0.00530	0.00460	0.00670	0.00000	0.00000	0.00102
39	0.00108	0.00175	0.00232	0.00345	0.00314	0.00280	0.00428	0.00409	0.00260
40	0.01431	0.00817	0.01553	0.01235	0.01950	0.00780	0.02396	0.00907	0.00873
41	0.00435	0.00194	0.00062	0.00000	0.00113	0.00112	0.00000	0.00000	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00013	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
44	0.00035	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
45	0.00066	0.00051	0.00089	0.00020	0.00012	0.00031	0.00020	0.00023	0.00017
46	0.04889	0.00000	0.00000	0.00000	0.00000	0.00000	0.00037	0.00000	0.00043
47	0.04781	0.06359	0.01114	0.00396	0.01830	0.00523	0.00744	0.00012	0.00040
48	0.01824	0.01453	0.06263	0.00455	0.00333	0.00638	0.00321	0.00235	0.00274
49	0.00032	0.00000	0.00000	0.20342	0.00000	0.00223	0.00000	0.00000	0.00116
50	0.00025	0.00000	0.00000	0.00000	0.02609	0.00000	0.00626	0.00000	0.00005
51	0.00996	0.01106	0.00249	0.01082	0.03087	0.02853	0.01590	0.00773	0.00230
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00047	0.00000	0.00001
53	0.00000	0.00000	0.00000	0.00071	0.00075	0.00225	0.00225	0.00584	0.00189
54	0.00011	0.00006	0.00000	0.00142	0.00000	0.00006	0.00009	0.00012	0.06011
55	0.00041	0.00040	0.00000	0.02934	0.00000	0.00603	0.00000	0.00072	0.03980
56	0.00000	0.00001	0.00073	0.00000	0.00005	0.00000	0.00046	0.00334	0.00012
57	0.00007	0.00000	0.00036	0.00002	0.00000	0.00000	0.00000	0.00000	0.00001
58	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00003
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
60	0.00015	0.00042	0.00017	0.00057	0.00301	0.00038	0.00737	0.00007	0.00030
61	0.00012	0.00007	0.00007	0.00008	0.00004	0.00007	0.00005	0.00007	0.00009
62	0.00004	0.00005	0.00020	0.00086	0.00078	0.00042	0.00113	0.00005	0.00012
63	0.00162	0.01026	0.01720	0.02023	0.01149	0.01749	0.01323	0.01293	0.01008
64	0.00637	0.00421	0.00472	0.00754	0.00333	0.00670	0.00220	0.00364	0.00568
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00054	0.00053	0.00073	0.00045	0.00040	0.00070	0.00046	0.00047	0.00036
67	0.02234	0.02361	0.01538	0.03180	0.02519	0.02074	0.02756	0.02069	0.01851
68	0.00594	0.00469	0.00581	0.01112	0.00349	0.00530	0.00367	0.00364	0.00515
69	0.02418	0.00854	0.01866	0.05696	0.00768	0.01519	0.01387	0.01082	0.01477
70	0.00205	0.00113	0.00279	0.00881	0.00246	0.01749	0.00239	0.00364	0.01252
71	0.01813	0.01797	0.01769	0.03434	0.02044	0.02897	0.03463	0.01893	0.03618
72	0.00723	0.00599	0.00659	0.02418	0.00333	0.00887	0.00349	0.00459	0.01219
73	0.00162	0.00196	0.00182	0.00291	0.00277	0.00191	0.00055	0.00306	0.00261
74	0.00006	0.00020	0.00007	0.00051	0.00005	0.00001	0.00011	0.00007	0.00028
75	0.00021	0.00019	0.00023	0.00031	0.00011	0.00025	0.00019	0.00025	0.00029
76	0.00162	0.00119	0.00097	0.00149	0.00063	0.00115	0.00156	0.00071	0.00198
77	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00003
78	0.00161	0.00029	0.00151	0.00025	0.00148	0.00017	0.02335	0.00927	0.00042
79	0.00165	0.00093	0.00119	0.00056	0.03100	0.00072	0.00179	0.01385	0.00051
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
81	0.00368	0.00534	0.00534	0.00265	0.00297	0.00545	0.00637	0.02723	0.00173
TI	0.34019	0.26439	0.26592	0.52764	0.29938	0.28813	0.32254	0.26492	0.28283
VA	0.65981	0.73561	0.73408	0.47236	0.70062	0.71187	0.67746	0.73508	0.71717
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK7	55	56	57	58	59	60	61	62	63
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00007
2	0.00006	0.00000	0.00001	0.00015	0.00006	0.00012	0.00000	0.00205	0.00018
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00008	0.00003
4	0.00013	0.00000	0.00003	0.00015	0.00013	0.00006	0.00008	0.00005	0.00000
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00011	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00006	0.00006	0.00000	0.00097	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00223	0.00163	0.00119	0.00365	0.00176	0.00159	0.00493	0.00261	0.02912
11	0.00000	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00049	0.00019	0.00007	0.00131	0.00032	0.00211	0.00028	0.00219	0.00264
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00003	0.00011	0.00005	0.00071	0.00000	0.00140	0.00001
15	0.00000	0.00020	0.00160	0.00028	0.00910	0.00345	0.00022	0.00347	0.00052
16	0.00033	0.00048	0.00012	0.00030	0.00082	0.00046	0.00014	0.00045	0.00039
17	0.00000	0.00000	0.00628	0.00000	0.00135	0.00000	0.00000	0.00128	0.00040
18	0.00000	0.00103	0.00080	0.00021	0.03587	0.00254	0.00022	0.02177	0.00009
19	0.00000	0.00000	0.00011	0.00022	0.00000	0.00000	0.00000	0.00033	0.00000
20	0.00030	0.00000	0.00000	0.00000	0.00329	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00072	0.00046	0.00116	0.00000	0.00000	0.00000	0.00000
22	0.00139	0.00029	0.00030	0.00043	0.00074	0.00341	0.01310	0.00797	0.00075
23	0.00150	0.00164	0.00036	0.00026	0.00005	0.00179	0.00237	0.00764	0.00019
24	0.00036	0.00077	0.00017	0.00189	0.00045	0.00075	0.00034	0.00062	0.00145
25	0.01138	0.01497	0.00103	0.00066	0.00089	0.00070	0.03627	0.00488	0.00091
26	0.00012	0.00015	0.00002	0.00006	0.00010	0.00013	0.00005	0.00052	0.00000
27	0.00000	0.00000	0.00000	0.00000	0.00001	0.00003	0.00000	0.00002	0.00001
28	0.00002	0.00008	0.00095	0.00076	0.00384	0.00032	0.00000	0.00199	0.00012
29	0.00019	0.00011	0.00011	0.00035	0.00038	0.00029	0.00024	0.00051	0.00370
30	0.02278	0.02408	0.02167	0.00227	0.01492	0.01780	0.02149	0.04159	0.00699
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00054	0.00000
32	0.00000	0.00000	0.00000	0.00002	0.00000	0.00005	0.00000	0.00033	0.00000
33	0.01425	0.00022	0.00710	0.00012	0.00548	0.00370	0.00364	0.00056	0.00020
34	0.00560	0.00316	0.00295	0.00096	0.00617	0.00194	0.00032	0.00615	0.00029
35	0.00329	0.00612	0.01802	0.00843	0.03822	0.00487	0.00563	0.00868	0.00108
36	0.01481	0.04051	0.00403	0.01532	0.01259	0.01343	0.01401	0.02325	0.00015
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00017	0.00000	0.00000	0.00000
38	0.00000	0.00000	0.00012	0.00000	0.04848	0.00288	0.00008	0.00000	0.00000
39	0.00322	0.00082	0.01013	0.00162	0.00159	0.00300	0.00109	0.00132	0.00007
40	0.01318	0.01388	0.01805	0.01126	0.02073	0.01206	0.00532	0.01154	0.00222
41	0.00000	0.00000	0.00246	0.00026	0.01430	0.00000	0.00000	0.00002	0.00061
42	0.00000	0.00000	0.00002	0.00000	0.00027	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00510	0.00000	0.00000	0.00000	0.00000
44	0.00000	0.00000	0.00003	0.00000	0.00145	0.00000	0.00000	0.00013	0.00003
45	0.00149	0.00026	0.00011	0.00046	0.00019	0.00017	0.00000	0.00002	0.00001
46	0.00000	0.00000	0.00000	0.00000	0.00145	0.00000	0.00000	0.00010	0.00000
47	0.00025	0.01166	0.00326	0.00800	0.03261	0.00129	0.00323	0.00128	0.00257
48	0.00312	0.00163	0.00868	0.02423	0.00554	0.00564	0.00162	0.00184	0.00057
49	0.00032	0.00000	0.00001	0.00227	0.00013	0.00029	0.00000	0.00000	0.00002
50	0.00000	0.00000	0.00194	0.00000	0.00912	0.00000	0.00000	0.00016	0.00004
51	0.00116	0.00203	0.00032	0.00059	0.00618	0.00565	0.00102	0.00126	0.00038
52	0.00000	0.00000	0.00000	0.00000	0.00059	0.00000	0.00000	0.00000	0.00000
53	0.00022	0.00110	0.00068	0.00001	0.00082	0.00077	0.00028	0.00021	0.00005
54	0.00006	0.00000	0.00256	0.04411	0.00749	0.00006	0.00008	0.00056	0.00024
55	0.03367	0.00244	0.00018	0.00701	0.00012	0.00405	0.00567	0.00094	0.00016
56	0.00010	0.00611	0.00222	0.00064	0.00026	0.00045	0.00002	0.00006	0.00022
57	0.00000	0.00003	0.03042	0.00000	0.00354	0.00004	0.00002	0.00001	0.00081
58	0.00000	0.00000	0.00002	0.18621	0.00000	0.00000	0.00000	0.00000	0.00622
59	0.00000	0.00000	0.00009	0.00000	0.02375	0.00000	0.00000	0.00017	0.00394
60	0.00034	0.00012	0.00035	0.00251	0.00146	0.00991	0.00037	0.00025	0.00015
61	0.00007	0.00006	0.00005	0.00142	0.00014	0.00050	0.01458	0.00009	0.00005
62	0.00005	0.00004	0.00006	0.00016	0.00067	0.00106	0.00132	0.01270	0.00016
63	0.01292	0.01318	0.01232	0.01677	0.01882	0.01375	0.01261	0.02233	0.12723
64	0.00477	0.00283	0.00093	0.00561	0.00334	0.00517	0.00444	0.00502	0.01337
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00057	0.00044	0.00025	0.00054	0.00044	0.00035	0.00032	0.00046	0.00057
67	0.01686	0.01482	0.03033	0.01573	0.04029	0.01792	0.02101	0.03032	0.02086
68	0.00700	0.00839	0.00229	0.00527	0.00598	0.00476	0.01002	0.01014	0.02239
69	0.01177	0.01525	0.00120	0.00708	0.00724	0.00975	0.00800	0.01675	0.01951
70	0.00891	0.00599	0.00110	0.01131	0.00246	0.00482	0.00493	0.00528	0.00173
71	0.02736	0.02647	0.01311	0.03900	0.02279	0.03260	0.04040	0.04712	0.04146
72	0.01038	0.00441	0.00136	0.02980	0.00623	0.00781	0.00582	0.00670	0.00864
73	0.00280	0.00501	0.00603	0.00200	0.00101	0.00300	0.00202	0.00215	0.02332
74	0.00011	0.00006	0.00003	0.00037	0.00007	0.00024	0.00018	0.00006	0.00023
75	0.00033	0.00031	0.00007	0.00032	0.00022	0.00029	0.00078	0.00066	0.00024
76	0.00115	0.00054	0.00063	0.00215	0.00113	0.00147	0.00089	0.00200	0.00136
77	0.00006	0.00000	0.00002	0.00004	0.00000	0.00011	0.00008	0.00063	0.00170
78	0.00441	0.02439	0.00386	0.00080	0.00648	0.00221	0.00181	0.00228	0.24056
79	0.00501	0.01150	0.00852	0.00075	0.00403	0.00283	0.00366	0.00086	0.01293
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
81	0.02516	0.03008	0.01476	0.00533	0.01079	0.00990	0.00910	0.00611	0.00121
TI	0.27605	0.29959	0.24624	0.47202	0.45511	0.22529	0.26410	0.33343	0.60512
VA	0.72395	0.70041	0.75376	0.52798	0.54489	0.77471	0.73590	0.66657	0.39488
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK8	64	65	66	67	68	69	70	71	72
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00807
2	0.00002	0.00000	0.00021	0.00008	0.00012	0.00131	0.00095	0.00020	0.01921
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00633
4	0.00426	0.00016	0.00166	0.00057	0.00004	0.00494	0.00084	0.00011	0.00000
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.03402	0.00426	0.03170	0.00406	0.00473	0.07876	0.01375	0.01039	0.00483
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00007	0.00000
12	0.00027	0.00013	0.00018	0.00059	0.00091	0.00009	0.00222	0.00108	0.42342
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00034	0.00000	0.00000
15	0.00000	0.00000	0.00000	0.00006	0.00000	0.00000	0.00045	0.00027	0.00000
16	0.00038	0.00000	0.00018	0.00012	0.00000	0.00001	0.00898	0.00062	0.00000
17	0.00000	0.00000	0.00000	0.00025	0.00035	0.00000	0.00392	0.00009	0.00036
18	0.00000	0.00000	0.00000	0.00013	0.00000	0.00000	0.00087	0.00062	0.00000
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00075	0.00034	0.00033	0.00287	0.00362	0.00015	0.00439	0.00434	0.00329
23	0.00000	0.00000	0.00000	0.00072	0.00000	0.00000	0.00103	0.00049	0.00322
24	0.00336	0.00079	0.00088	0.00144	0.01452	0.00030	0.00264	0.01329	0.00096
25	0.00004	0.00000	0.00184	0.00006	0.00006	0.00045	0.00427	0.00619	0.00041
26	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00000	0.00000	0.00000	0.00002	0.00000	0.00000	0.00049	0.00019	0.00015
28	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00018	0.00026	0.00000
29	0.00005	0.00016	0.00228	0.00072	0.00026	0.00031	0.00113	0.00121	0.00002
30	0.00036	0.00063	0.00062	0.00250	0.00068	0.00187	0.01183	0.01150	0.00480
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00000	0.00001	0.00002	0.00000	0.00061	0.00005	0.00000
33	0.00002	0.00000	0.00000	0.00030	0.00004	0.00000	0.00054	0.00114	0.00124
34	0.00000	0.00000	0.00000	0.00005	0.00002	0.00000	0.00332	0.00132	0.00132
35	0.00001	0.00000	0.00006	0.00001	0.00000	0.00000	0.00008	0.00022	0.00000
36	0.00030	0.00000	0.00007	0.00000	0.00000	0.00000	0.00009	0.00000	0.00014
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00005	0.00000
38	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00000	0.00000	0.00000
39	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00034	0.00071	0.00024
40	0.00000	0.00000	0.00018	0.00027	0.00002	0.00000	0.00547	0.00572	0.00008
41	0.00000	0.00000	0.00079	0.00000	0.00000	0.00000	0.00068	0.00116	0.00000
42	0.00000	0.00000	0.00000	0.00002	0.00000	0.00007	0.00000	0.00238	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
44	0.00000	0.00000	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000
45	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00002	0.00000
46	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00050	0.00057
47	0.00000	0.00000	0.00062	0.00001	0.00002	0.00002	0.00041	0.00222	0.00000
48	0.00000	0.00000	0.00000	0.00028	0.00000	0.00001	0.00174	0.00444	0.00011
49	0.00016	0.00000	0.00021	0.00008	0.00050	0.00000	0.00412	0 00450	0.00000
50	0.00000	0.00000	0.00000	0.00021	0.00000	0.00000	0.00144	0.00043	0.00000
51	0.00000	0.00000	0.00016	0.00000	0.00000	0.00000	0.00064	0.00263	0.00000
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00025	0.00002	0.00000
53	0.00014	0.00003	0.00025	0.00002	0.00003	0.00001	0.00007	0.00001	0.00003
54	0.02612	0.00221	0.00000	0.00002	0.00012	0.00001	0.00005	0.00015	0.00000
55	0.00046	0.00233	0.00000	0.00001	0.00005	0.00000	0.00277	0.00156	0.00000
56	0.00003	0.00000	0.00000	0.00003	0.00002	0.00001	0.00005	0.00006	0.00000
57	0.00001	0.00000	0.00005	0.00006	0.00003	0.00001	0.00009	0.00009	0.00000
58	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
59	0.00019	0.00026	0.00000	0.00002	0.00008	0.00001	0.00049	0.00111	0.00000
60	0.00000	0.00000	0.00000	0.00001	0.00001	0.00000	0.00069	0.00005	0.00000
61	0.00012	0.00090	0.00012	0.00007	0.00021	0.00003	0.00286	0.00483	0.00000
62	0.00018	0.00006	0.00008	0.00013	0.00033	0.00004	0.00493	0.00217	0.00047
63	0.00399	0.01121	0.00808	0.01288	0.00535	0.00182	0.00839	0.04341	0.01946
64	0.01921	0.03331	0.00373	0.01567	0.03068	0.00223	0.01610	0.04477	0.00426
65	0.00000	0.00090	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00063	0.00110	0.01368	0.00110	0.00077	0.00046	0.00172	0.00081	0.00145
67	0.00227	0.00284	0.00601	0.01184	0.00501	0.00294	0.02108	0.01892	0.06551
68	0.01105	0.01373	0.00746	0.01296	0.19747	0.02128	0.01667	0.02367	0.01249
69	0.02983	0.08082	0.00953	0.04543	0.04591	0.08246	0.08442	0.10695	0.06011
70	0.00668	0.01152	0.00456	0.00484	0.00521	0.00156	0.03797	0.02440	0.01607
71	0.04413	0.08208	0.01368	0.06157	0.10525	0.01920	0.06226	0.17596	0.03788
72	0.00589	0.00521	0.00207	0.01363	0.02477	0.00256	0.00746	0.02624	0.00000
73	0.00471	0.00189	0.00249	0.01492	0.00564	0.00256	0.01527	0.02897	0.00064
74	0.00036	0.15281	0.00012	0.00011	0.00030	0.00004	0.00008	0.00403	0.00638
75	0.00025	0.00038	0.00006	0.00035	0.00127	0.00005	0.00034	0.00092	0.00069
76	0.00539	0.00126	0.00228	0.00434	0.02111	0.00312	0.00237	0.01694	0.00152
77	0.00079	0.00178	0.00019	0.00093	0.00050	0.00051	0.00162	0.00081	0.00107
78	0.00007	0.00007	0.00005	0.00070	0.00007	0.00007	0.00048	0.00106	0.00114
79	0.00010	0.00038	0.00146	0.00105	0.00023	0.00024	0.00183	0.00360	0.00144
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
81	0.00629	0.02195	0.01820	0.01249	0.00118	0.00123	0.00806	0.01792	0.01838
TI	0.21289	0.43550	0.13612	0.23066	0.47751	0.23084	0.37613	0.62784	0.72776
VA	0.78711	0.56450	0.86388	0.76934	0.52249	0.76916	0.62387	0.37216	0.27224
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLVIII (Continued)

AOK9	73	74	75	76	77	78	79	80	81
1	0.00000	0.00369	0.00131	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00005	0.04758	0.00079	0.01003	0.00048	0.00001	0.00013	0.00000	0.00018
3	0.00000	0.00000	0.00006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00000	0.00724	0.00112	0.00000	0.00119	0.00000	0.00103	0.00000	0.00166
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00076	0.00002	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00044	0.00021	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.01108	0.01594	0.01884	0.01545	0.20421	0.01243	0.02765	0.00573	0.03165
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00024	0.00262	0.01780	0.00156	0.00024	0.00050	0.00013	0.00000	0.00018
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00001	0.00003	0.00000	0.00000	0.00000	0.00017	0.00000
15	0.00000	0.00064	0.00002	0.00020	0.00009	0.00000	0.00000	0.00000	0.00000
16	0.00247	0.00017	0.00179	0.00000	0.00175	0.00001	0.00013	0.00026	0.00017
17	0.00000	0.00041	0.00150	0.00125	0.00010	0.00000	0.00000	0.00000	0.00000
18	0.00000	0.00000	0.00014	0.00000	0.00000	0.00003	0.00000	0.03556	0.00000
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00180	0.00061	0.00171	0.00152	0.00099	0.00609	0.00021	0.00110	0.00033
23	0.00000	0.00000	0.00034	0.00016	0.00000	0.00047	0.00000	0.00000	0.00000
24	0.00023	0.00326	0.00798	0.00463	0.00302	0.00003	0.00057	0.00004	0.00089
25	0.00016	0.00171	0.00523	0.00091	0.02051	0.00989	0.00202	0.00594	0.00184
26	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000
27	0.00000	0.00001	0.00075	0.00020	0.00012	0.00004	0.00000	0.00000	0.00000
28	0.00353	0.00000	0.00005	0.00003	0.00002	0.00002	0.00001	0.00000	0.00000
29	0.00134	0.00024	0.00056	0.00059	0.00191	0.00229	0.00148	0.00012	0.00228
30	0.02869	0.00085	0.00795	0.00329	0.00100	0.00059	0.00042	0.00614	0.00062
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00001	0.00041	0.00002	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000
33	0.00797	0.00005	0.00115	0.00022	0.00033	0.00001	0.00003	0.00000	0.00000
34	0.01710	0.00000	0.00022	0.00007	0.00067	0.00115	0.00005	0.00372	0.00000
35	0.00000	0.00000	0.00004	0.00002	0.00014	0.00032	0.00037	0.00235	0.00005
36	0.00000	0.00000	0.00000	0.00010	0.00000	0.00032	0.00005	0.00067	0.00007
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00529	0.00000	0.00000	0.00000
38	0.00000	0.00000	0.00000	0.00007	0.00005	0.00015	0.00018	0.00000	0.00000
39	0.00451	0.00000	0.00008	0.00022	0.00007	0.00000	0.00000	0.00160	0.00000
40	0.01369	0.00008	0.00051	0.00025	0.00099	0.00101	0.00077	0.00246	0.00019
41	0.00143	0.00000	0.00000	0.00014	0.00067	0.00012	0.00065	0.00045	0.00079
42	0.00000	0.00000	0.00000	0.00000	0.00016	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00007	0.00176	0.00107	0.00547	0.04393	0.00000
44	0.00000	0.00000	0.00000	0.00005	0.00000	0.00009	0.00000	0.00137	0.00000
45	0.00001	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00001	0.00000
46	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
47	0.00088	0.00024	0.00006	0.00015	0.00029	0.00116	0.00112	0.00100	0.00062
48	0.01580	0.00000	0.00000	0.00000	0.00019	0.00062	0.00067	0.00053	0.00000
49	0.00000	0.00000	0.00015	0.00044	0.00000	0.00000	0.00013	0.00000	0.00021
50	0.03411	0.00033	0.00008	0.00011	0.00007	0.00000	0.00000	0.00000	0.00000
51	0.00035	0.00000	0.00000	0.00000	0.00074	0.00033	0.00051	0.00016	0.00016
52	0.00000	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000
53	0.00152	0.00004	0.00014	0.00003	0.00023	0.00001	0.00017	0.00029	0.00025
54	0.00760	0.00014	0.00011	0.00015	0.00005	0.00003	0.00002	0.00000	0.00000
55	0.00000	0.00000	0.00008	0.00002	0.00003	0.00000	0.00000	0.00000	0.00000
56	0.00083	0.00001	0.00001	0.00003	0.00021	0.00000	0.00000	0.00001	0.00000
57	0.08344	0.00002	0.00001	0.00027	0.00059	0.00000	0.00003	0.00003	0.00005
58	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002	0.00003	0.00000	0.00000
59	0.00034	0.00031	0.00011	0.00024	0.00097	0.00000	0.00000	0.00000	0.00000
60	0.00000	0.00000	0.00272	0.00002	0.00009	0.00007	0.00000	0.00002	0.00000
61	0.00003	0.00298	0.00185	0.00029	0.00008	0.00004	0.00008	0.00000	0.00012
62	0.00008	0.00072	0.00108	0.00024	0.00014	0.00003	0.00007	0.00015	0.00009
63	0.02248	0.00705	0.01077	0.14025	0.01631	0.02444	0.00592	0.00650	0.00806
64	0.01224	0.00728	0.01074	0.00403	0.00801	0.00106	0.00272	0.00071	0.00373
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00079	0.00085	0.00161	0.00220	0.00859	0.00268	0.01120	0.01925	0.01364
67	0.09001	0.01253	0.01303	0.00381	0.00944	0.00311	0.00437	0.01695	0.00599
68	0.01877	0.01476	0.01269	0.01596	0.00825	0.00272	0.00552	0.00407	0.00745
69	0.07555	0.08055	0.07193	0.03287	0.01774	0.02282	0.02987	0.03070	0.00952
70	0.00297	0.01050	0.01284	0.00673	0.00167	0.00030	0.00300	0.00053	0.00455
71	0.04459	0.06579	0.04985	0.04019	0.03673	0.01057	0.01195	0.01907	0.01366
72	0.00519	0.02247	0.01519	0.00508	0.00751	0.00139	0.00210	0.00089	0.00207
73	0.00547	0.00487	0.00417	0.00739	0.00248	0.00037	0.00118	0.00260	0.00248
74	0.00005	0.09339	0.00113	0.00063	0.00005	0.00036	0.00009	0.00000	0.00012
75	0.00018	0.00048	0.00295	0.00008	0.00014	0.00003	0.00005	0.00012	0.00006
76	0.00079	0.00194	0.00808	0.00249	0.00134	0.00026	0.00150	0.00035	0.00228
77	0.00153	0.00058	0.00073	0.00076	0.00018	0.00023	0.00019	0.00017	0.00020
78	0.00090	0.00071	0.00016	0.00165	0.00147	0.01321	0.02972	0.02542	0.00347
79	0.03166	0.00245	0.00499	0.02749	0.02944	0.02136	0.03283	0.00000	0.26392
80	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00586
81	0.01531	0.02209	0.00957	0.04586	0.05338	0.01377	0.02052	0.04252	0.14664
TI	0.56777	0.43859	0.30680	0.38103	0.44710	0.16369	0.20693	0.28366	0.53610
VA	0.43223	0.56141	0.69320	0.61897	0.55290	0.83631	0.79307	0.71634	0.46390
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX

REST OF U.S. DIRECT COEFFICIENT MATRIX, 1977

ARUS1	1	2	3	4	5	6	7	8	9
1	0.21251	0.01528	0.00000	0.06243	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.34332	0.03055	0.00000	0.02112	0.00000	0.00000	0.00000	0.00000	0.00122
3	0.00000	0.00000	0.00461	0.00294	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.02939	0.02437	0.02644	0.03238	0.00000	0.00000	0.00000	0.00000	0.00057
5	0.00000	0.00000	0.00000	0.00000	0.02365	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00414	0.10605	0.00000	0.00000	0.00000
7	0.00004	0.00306	0.00000	0.00066	0.00532	0.00050	0.03624	0.01478	0.01292
8	0.00000	0.00187	0.00000	0.00000	0.00000	0.00000	0.00000	0.03407	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00476	0.00560	0.00000	0.01509	0.02719	0.00621	0.00613	0.00554	0.00019
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00007
12	0.15230	0.00001	0.02800	0.00942	0.00000	0.00000	0.00000	0.00046	0.00019
13	0.00001	0.00000	0.00000	0.00034	0.00000	0.00000	0.00000	0.00000	0.00004
14	0.00000	0.00016	0.00000	0.00000	0.00000	0.00032	0.00000	0.00048	0.00000
15	0.00023	0.00105	0.02471	0.00957	0.00000	0.00000	0.00000	0.00000	0.00303
16	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00044	0.00000	0.00005
17	0.00000	0.00024	0.00718	0.00239	0.00000	0.00000	0.00000	0.00000	0.00001
18	0.00015	0.00007	0.00000	0.00000	0.00236	0.00424	0.00000	0.00046	0.06157
19	0.00002	0.00248	0.00000	0.00442	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00041
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00170
22	0.00193	0.00045	0.00000	0.00146	0.00000	0.00000	0.00482	0.00184	0.00257
23	0.00003	0.00006	0.00000	0.03484	0.00000	0.00000	0.00000	0.00000	0.00003
24	0.00018	0.00011	0.00201	0.00276	0.00000	0.00000	0.00044	0.00000	0.00014
25	0.00279	0.09421	0.01924	0.04764	0.02659	0.04261	0.01752	0.01568	0.00353
26	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00160	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00000	0.00000	0.00490	0.00000	0.00000	0.00000	0.00000	0.00000	0.00420
29	0.00038	0.00154	0.00227	0.00182	0.00118	0.00084	0.00260	0.00091	0.00113
30	0.00219	0.00396	0.00168	0.00108	0.01300	0.01519	0.00921	0.00181	0.00816
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00029	0.00000	0.00000	0.00053	0.00000	0.00000	0.00000	0.00000	0.00000
33	0.00006	0.00000	0.00000	0.00037	0.00059	0.00028	0.00022	0.00000	0.00087
34	0.00000	0.00017	0.00000	0.00367	0.00236	0.00733	0.00066	0.00046	0.07001
35	0.00019	0.00011	0.00000	0.00000	0.04965	0.02539	0.02651	0.01383	0.02785
36	0.00000	0.00000	0.00000	0.00000	0.00472	0.00142	0.00374	0.00046	0.01851
37	0.00000	0.00000	0.02215	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.00011	0.00008	0.00000	0.00000	0.00000	0.00000	0.00217	0.00183	0.09991
39	0.00028	0.00000	0.00000	0.00000	0.00118	0.00199	0.00177	0.00325	0.00040
40	0.00100	0.00105	0.02213	0.00957	0.01418	0.00734	0.00788	0.00092	0.02670
41	0.00000	0.00000	0.01152	0.00663	0.00532	0.00369	0.01404	0.00464	0.00000
42	0.00355	0.00493	0.00000	0.00497	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.02483	0.02303	0.04555	0.01470	0.00356
44	0.00000	0.00000	0.00000	0.00000	0.00236	0.00197	0.00920	0.00232	0.00429
45	0.00000	0.00000	0.00000	0.00000	0.00059	0.00006	0.00000	0.00000	0.00000
46	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
47	0.00013	0.00027	0.01019	0.00000	0.00472	0.00084	0.00582	0.00228	0.00320
48	0.00019	0.00014	0.00000	0.00000	0.00000	0.00389	0.00087	0.00000	0.00008
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00578
51	0.00000	0.00000	0.00000	0.00000	0.00236	0.00114	0.00154	0.00093	0.00601
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00112
53	0.00005	0.00000	0.00113	0.00000	0.00059	0.00030	0.00020	0.00000	0.01238
54	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00058
55	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00020	0.00045	0.00000	0.00205	0.00000	0.00055	0.00020	0.00000	0.00030
57	0.00035	0.00026	0.00000	0.00370	0.01655	0.00057	0.00461	0.00091	0.00022
58	0.00000	0.00000	0.00000	0.00147	0.00000	0.00000	0.00000	0.00000	0.00000
59	0.00000	0.00000	0.02702	0.00074	0.00177	0.00084	0.00000	0.00047	0.00000
60	0.00000	0.00000	0.00402	0.00000	0.00000	0.00028	0.00000	0.00000	0.00265
61	0.00002	0.00000	0.00000	0.00037	0.00000	0.00000	0.00000	0.00000	0.00005
62	0.00005	0.00002	0.00229	0.00110	0.00118	0.00112	0.00066	0.00139	0.00073
63	0.01365	0.00858	0.01775	0.03480	0.02069	0.01024	0.01030	0.00814	0.02015
64	0.00252	0.00174	0.00197	0.00630	0.00059	0.00055	0.00108	0.00045	0.00210
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00055	0.00028	0.00000	0.00074	0.00472	0.00197	0.00240	0.00321	0.00006
67	0.02463	0.02066	0.02603	0.02984	0.01832	0.01180	0.02201	0.00597	0.05002
68	0.01275	0.00802	0.01048	0.01251	0.00472	0.01112	0.01144	0.00819	0.00427
69	0.02267	0.09587	0.00840	0.03157	0.23229	0.01762	0.03631	0.02249	0.00462
70	0.00002	0.00001	0.00303	0.00601	0.00059	0.00135	0.00189	0.00044	0.00017
71	0.00404	0.00912	0.02410	0.07445	0.03428	0.01624	0.03310	0.01755	0.04956
72	0.00037	0.00023	0.00196	0.00735	0.00118	0.00128	0.00098	0.00090	0.00304
73	0.00261	0.00198	0.01065	0.01866	0.00236	0.00220	0.00940	0.00270	0.00321
74	0.00002	0.00000	0.00000	0.00019	0.00000	0.00000	0.00000	0.00000	0.00007
75	0.00517	0.00020	0.00060	0.00423	0.00118	0.00141	0.00134	0.00047	0.00040
76	0.00013	0.00008	0.00028	0.00143	0.00118	0.00055	0.00043	0.00135	0.00019
77	0.00000	0.00000	0.00029	0.00037	0.00414	0.00056	0.00109	0.00046	0.00005
78	0.01015	0.04212	0.18750	0.09300	0.03192	0.05874	0.19036	0.02492	0.03078
79	0.00427	0.00217	0.00087	0.00034	0.03665	0.03988	0.05053	0.02538	0.00047
80	0.00000	0.00001	0.00000	0.00000	0.00828	0.00072	0.00352	0.00138	0.00000
81	0.00598	0.00305	0.00087	0.01481	0.05142	0.05584	0.07050	0.03553	0.00006
TI	0.86780	0.38667	0.51629	0.62214	0.69090	0.49006	0.64970	0.28395	0.55613
VA	0.13220	0.61333	0.48371	0.37786	0.30910	0.50994	0.35030	0.71605	0.44387
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS2	10	11	12	13	14	15	16	17	18
1	0.00000	0.00000	0.18189	0.00000	0.00232	0.00541	0.00000	0.00000	0.00000
2	0.00022	0.00010	0.10375	0.23168	0.06110	0.00336	0.00074	0.00000	0.00000
3	0.00000	0.00000	0.00548	0.00000	0.00000	0.00000	0.00296	0.00000	0.07769
4	0.00012	0.00000	0.00000	0.00000	0.00000	0.00000	0.00017	0.00000	0.00051
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.02009	0.00000	0.00011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00009	0.00000	0.00004	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00042	0.00464	0.00175	0.00088	0.00222	0.00133	0.00082	0.00072	0.00274
11	0.00000	0.02814	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00035	0.00116	0.22411	0.00208	0.00318	0.00133	0.00057	0.00255	0.00015
13	0.00005	0.00019	0.00002	0.27759	0.00003	0.00000	0.00005	0.00000	0.00002
14	0.00000	0.00000	0.00000	0.00000	0.20272	0.18552	0.23606	0.23096	0.00000
15	0.00131	0.00010	0.00009	0.00000	0.00473	0.06614	0.00338	0.08197	0.00046
16	0.00009	0.00116	0.00014	0.00000	0.00038	0.00855	0.22005	0.00485	0.00029
17	0.00045	0.00077	0.00027	0.00000	0.00003	0.00354	0.01083	0.01956	0.00018
18	0.02685	0.00202	0.00015	0.00026	0.00282	0.00111	0.00085	0.00229	0.23775
19	0.00000	0.00318	0.00045	0.00060	0.00000	0.00000	0.00000	0.00000	0.00005
20	0.00020	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002
21	0.00080	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00325	0.00068	0.01073	0.01455	0.00128	0.00477	0.00408	0.01075	0.00128
23	0.00000	0.00291	0.01989	0.01083	0.00549	0.00821	0.01092	0.00955	0.00266
24	0.00031	0.00058	0.00514	0.00970	0.00023	0.00034	0.00124	0.00182	0.00015
25	0.00446	0.00628	0.00517	0.00000	0.03344	0.03494	0.00709	0.00169	0.01082
26	0.00000	0.00184	0.00000	0.00130	0.08833	0.09937	0.01732	0.00368	0.00184
27	0.00000	0.00046	0.00251	0.00000	0.00251	0.00091	0.00166	0.00000	0.00000
28	0.03321	0.00059	0.00000	0.00008	0.00031	0.00111	0.00000	0.00000	0.00363
29	0.00261	0.00029	0.00021	0.01732	0.00019	0.00022	0.00023	0.00012	0.00104
30	0.01149	0.00425	0.00920	0.00000	0.00395	0.02500	0.00424	0.02161	0.00522
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00400	0.00374	0.00000
32	0.00003	0.00010	0.00000	0.00000	0.00000	0.00000	0.00004	0.00000	0.00010
33	0.00140	0.00019	0.01255	0.00000	0.00232	0.00287	0.00000	0.00000	0.00130
34	0.03960	0.00145	0.00057	0.00052	0.00069	0.00077	0.00051	0.00048	0.00743
35	0.01074	0.06042	0.00052	0.00035	0.00030	0.00056	0.00037	0.00037	0.00405
36	0.00383	0.04049	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00043
37	0.00000	0.00000	0.03248	0.00008	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.03779	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00135
39	0.00075	0.00786	0.00188	0.00000	0.00000	0.00000	0.00000	0.00000	0.00325
40	0.01284	0.00966	0.00156	0.00398	0.00072	0.00000	0.00084	0.00000	0.03005
41	0.00000	0.00098	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00353	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00018
44	0.00755	0.00000	0.00000	0.00000	0.00103	0.00044	0.00020	0.00000	0.00116
45	0.00004	0.00203	0.00000	0.00008	0.00000	0.00000	0.00000	0.00000	0.00012
46	0.00000	0.00000	0.00062	0.00000	0.00651	0.00545	0.00135	0.00012	0.00242
47	0.00164	0.00524	0.00054	0.00069	0.00025	0.00218	0.00041	0.00000	0.00149
48	0.00026	0.00390	0.00031	0.00052	0.00108	0.00088	0.00053	0.00035	0.00126
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.01401	0.00000	0.00015	0.00000	0.00006	0.00000	0.00000	0.00000	0.00013
51	0.00450	0.00154	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00035
52	0.00534	0.00000	0.00000	0.00000	0.00000	0.00000	0.00068	0.00093	0.00000
53	0.01941	0.00000	0.00000	0.00000	0.00005	0.00000	0.00000	0.00000	0.00035
54	0.00154	0.01789	0.00001	0.00000	0.00003	0.00000	0.00003	0.00000	0.00003
55	0.00000	0.01545	0.00000	0.00000	0.00025	0.00000	0.00000	0.00000	0.00000
56	0.00042	0.00000	0.00000	0.00000	0.00000	0.00000	0.00005	0.00000	0.00020
57	0.00044	0.00174	0.00009	0.00000	0.00004	0.00000	0.00004	0.00000	0.00126
58	0.00000	0.06428	0.00001	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010
60	0.00344	0.00483	0.00007	0.00000	0.00042	0.00000	0.00000	0.00000	0.00032
61	0.00003	0.00009	0.00002	0.00000	0.00041	0.00067	0.00008	0.00012	0.00005
62	0.00251	0.00039	0.00005	0.00000	0.00007	0.00022	0.01291	0.00361	0.00044
63	0.02480	0.01165	0.02285	0.02130	0.01287	0.02115	0.01456	0.01704	0.02371
64	0.00440	0.00652	0.00144	0.00078	0.00205	0.00346	0.00470	0.00366	0.00143
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00012	0.00077	0.00052	0.00017	0.00081	0.00077	0.00048	0.00036	0.00056
67	0.06080	0.01125	0.03098	0.00442	0.02537	0.03006	0.03572	0.02800	0.02557
68	0.00770	0.00438	0.00363	0.00442	0.00250	0.00262	0.00695	0.00476	0.00529
69	0.00959	0.00792	0.00437	0.00346	0.00537	0.01251	0.01257	0.01460	0.00554
70	0.00037	0.00390	0.00213	0.00459	0.00148	0.00457	0.00435	0.00475	0.00157
71	0.01824	0.04185	0.02631	0.06764	0.01253	0.01953	0.02491	0.01424	0.01191
72	0.00635	0.02167	0.00136	0.00130	0.00244	0.00173	0.00384	0.00212	0.00184
73	0.00485	0.00254	0.00252	0.00095	0.00079	0.00119	0.00131	0.00106	0.00663
74	0.00014	0.00049	0.00009	0.00017	0.00003	0.00000	0.00018	0.00024	0.00010
75	0.00080	0.00195	0.00087	0.00043	0.00134	0.00054	0.00220	0.00329	0.00101
76	0.00044	0.00273	0.00066	0.00233	0.00073	0.00087	0.00266	0.00118	0.00040
77	0.00011	0.00000	0.00013	0.00234	0.00003	0.00000	0.00006	0.00000	0.00031
78	0.07136	0.00783	0.00556	0.00138	0.00507	0.00597	0.00608	0.00326	0.02830
79	0.00096	0.00599	0.00407	0.00052	0.00636	0.00675	0.00374	0.00277	0.00439
80	0.00000	0.00155	0.00057	0.00016	0.00097	0.00012	0.00011	0.00048	0.00332
81	0.00135	0.00841	0.00570	0.00190	0.00889	0.00940	0.00523	0.00386	0.00616
TI	0.49029	0.43927	0.73630	0.69135	0.51917	0.58640	0.67497	0.50751	0.53237
VA	0.50971	0.56073	0.26370	0.30865	0.48083	0.41360	0.32503	0.49249	0.46763
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS3	19	20	21	22	23	24	25	26	27
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00032
2	0.00000	0.00000	0.00000	0.00100	0.00000	0.00006	0.00099	0.00000	0.00165
3	0.00000	0.00000	0.00000	0.00016	0.00000	0.00000	0.00016	0.00000	0.00016
4	0.00000	0.00048	0.00000	0.00013	0.00007	0.00014	0.00013	0.00010	0.00023
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00040	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00020	0.00000	0.00000	0.00479	0.00015	0.00000
7	0.00000	0.00000	0.00000	0.00584	0.00000	0.00000	0.00584	0.00000	0.00093
8	0.00000	0.00000	0.00000	0.00056	0.00000	0.00000	0.01748	0.00014	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00082	0.00181	0.00179	0.00766	0.00493	0.00306	0.00451	0.00662	0.00515
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00000	0.00516	0.00029	0.01348	0.00015	0.00052	0.00697	0.00318	0.01788
13	0.00000	0.00009	0.00015	0.00005	0.00007	0.00012	0.00005	0.00005	0.00016
14	0.00000	0.04808	0.00352	0.00632	0.00000	0.00032	0.00000	0.00152	0.00000
15	0.00000	0.01778	0.01311	0.00413	0.00000	0.00084	0.00000	0.00000	0.00003
16	0.00000	0.00248	0.00284	0.00025	0.00030	0.00038	0.00005	0.00015	0.00007
17	0.00000	0.00143	0.00372	0.00000	0.00000	0.00004	0.00020	0.00000	0.00025
18	0.21362	0.13983	0.05531	0.07034	0.00007	0.00000	0.00106	0.00030	0.00016
19	0.00490	0.00019	0.00015	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00332	0.00030	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00745	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00000	0.00171	0.00045	0.21636	0.46148	0.16156	0.00544	0.02912	0.00929
23	0.00000	0.01669	0.00882	0.01532	0.01711	0.00218	0.00277	0.00896	0.02414
24	0.00000	0.00086	0.00104	0.00079	0.00038	0.13025	0.00038	0.00039	0.00398
25	0.00000	0.00191	0.00268	0.04333	0.02446	0.01967	0.19235	0.39391	0.09969
26	0.00000	0.00000	0.00061	0.01779	0.01349	0.00000	0.00736	0.04478	0.00123
27	0.00000	0.00000	0.00000	0.00091	0.00000	0.00000	0.00046	0.00342	0.04581
28	0.00000	0.01000	0.00642	0.00036	0.00000	0.00034	0.00098	0.00119	0.00113
29	0.00000	0.00029	0.00030	0.00084	0.00051	0.00016	0.00057	0.00053	0.00054
30	0.00000	0.05274	0.04358	0.01771	0.00131	0.00585	0.00419	0.01349	0.04667
31	0.00000	0.00123	0.00045	0.00000	0.00000	0.00006	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00000	0.00005	0.00000	0.00005	0.00010	0.00000	0.00005
33	0.00000	0.00465	0.00476	0.00003	0.00000	0.00002	0.00019	0.00035	0.00149
34	0.00000	0.00627	0.00372	0.00236	0.00060	0.00090	0.00131	0.00030	0.00068
35	0.02536	0.01959	0.08183	0.00041	0.00483	0.00037	0.00335	0.00026	0.00004
36	0.00000	0.00666	0.00686	0.00090	0.00151	0.00211	0.00846	0.00119	0.00058
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00584	0.00128	0.02503
38	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
39	0.00080	0.00621	0.01384	0.00000	0.00000	0.00000	0.00006	0.00000	0.00416
40	0.00082	0.05602	0.03397	0.00561	0.00127	0.00122	0.00123	0.00089	0.00550
41	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
44	0.00000	0.00000	0.00000	0.00008	0.00000	0.00009	0.00000	0.00000	0.00000
45	0.00000	0.00000	0.00025	0.00000	0.00055	0.00006	0.00000	0.00006	0.00006
46	0.00081	0.00122	0.00000	0.00381	0.00463	0.00282	0.00687	0.00624	0.00000
47	0.00000	0.00010	0.00162	0.00094	0.00030	0.00006	0.00417	0.00190	0.00090
48	0.00081	0.00094	0.00074	0.00089	0.00117	0.00032	0.00043	0.00083	0.00035
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00030	0.00000	0.00000
51	0.00000	0.00000	0.00164	0.00000	0.00000	0.00000	0.00025	0.00000	0.00000
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
53	0.00000	0.00049	0.00015	0.00010	0.00000	0.00000	0.00005	0.00005	0.00005
54	0.00000	0.00000	0.00000	0.00003	0.00000	0.00006	0.00003	0.00000	0.00006
55	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
57	0.00000	0.00009	0.00000	0.00000	0.00009	0.00004	0.00000	0.00000	0.00004
58	0.00000	0.00000	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
60	0.00000	0.00039	0.00000	0.00081	0.00000	0.00004	0.00053	0.00060	0.00120
61	0.00000	0.00039	0.00000	0.00005	0.00007	0.00405	0.00007	0.00005	0.00011
62	0.00000	0.00171	0.00120	0.00015	0.00068	0.00151	0.00005	0.00005	0.00049
63	0.02085	0.02339	0.02351	0.03592	0.04358	0.02774	0.02547	0.01972	0.02221
64	0.00160	0.00307	0.00219	0.00173	0.00379	0.00961	0.00182	0.00281	0.00402
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00000	0.00048	0.00060	0.00163	0.00052	0.00038	0.00208	0.00113	0.00042
67	0.02443	0.03776	0.03707	0.02831	0.01938	0.01848	0.01148	0.01618	0.02184
68	0.00725	0.00646	0.00719	0.00341	0.00308	0.00717	0.00353	0.00496	0.00555
69	0.00399	0.01094	0.01410	0.01266	0.01259	0.03888	0.01238	0.01065	0.02929
70	0.00785	0.00174	0.00344	0.00361	0.00544	0.00808	0.00180	0.00256	0.00967
71	0.00639	0.02467	0.01657	0.01932	0.01921	0.04641	0.02147	0.02515	0.15022
72	0.00160	0.00375	0.00437	0.00272	0.00291	0.00949	0.00389	0.00362	0.01508
73	0.00160	0.00259	0.00509	0.00115	0.00211	0.00330	0.00089	0.00116	0.00138
74	0.00000	0.00009	0.00016	0.00005	0.00007	0.00033	0.00010	0.00005	0.00045
75	0.00081	0.00201	0.00242	0.00067	0.00094	0.00356	0.00060	0.00101	0.00369
76	0.00080	0.00093	0.00101	0.00067	0.00080	0.01099	0.00054	0.00034	0.00148
77	0.00000	0.00010	0.00000	0.00110	0.00007	0.00010	0.00090	0.00054	0.00013
78	0.02044	0.00770	0.00805	0.02279	0.01410	0.00432	0.01764	0.01562	0.01488
79	0.00490	0.00371	0.00462	0.01276	0.00410	0.00296	0.01826	0.00934	0.00327
80	0.00000	0.00057	0.00134	0.00931	0.00029	0.00020	0.00532	0.00388	0.00049
81	0.00654	0.00523	0.00641	0.01788	0.00574	0.00414	0.02283	0.01241	0.00457
TI	0.35697	0.54598	0.44169	0.61550	0.67877	0.53540	0.44139	0.65316	0.58890
VA	0.64303	0.45402	0.55831	0.38450	0.32123	0.46460	0.55861	0.34684	0.41110
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS4	28	29	30	31	32	33	34	35	36
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00556	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000
3	0.00298	0.00000	0.00000	0.00000	0.00000	0.00000	0.00008	0.00000	0.00000
4	0.00000	0.00000	0.00020	0.00000	0.00000	0.00076	0.00023	0.00011	0.00040
5	0.00044	0.00000	0.00000	0.00000	0.00000	0.00000	0.00142	0.04787	0.00047
6	0.00237	0.00000	0.00005	0.00000	0.00000	0.00000	0.00286	0.00089	0.07728
7	0.00318	0.00194	0.00089	0.00000	0.00000	0.01501	0.09511	0.00452	0.00018
8	0.00000	0.00000	0.00148	0.00180	0.00000	0.00043	0.00441	0.00171	0.00002
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00209	0.00897	0.00364	0.00183	0.00129	0.00660	0.00608	0.01097	0.00295
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.02412	0.00082	0.00025	0.35998	0.00275	0.00011	0.00076	0.00018	0.00018
13	0.00015	0.00000	0.00005	0.00000	0.00016	0.00011	0.00008	0.00003	0.00002
14	0.00000	0.00000	0.01256	0.00000	0.03352	0.00000	0.00288	0.00000	0.00064
15	0.00000	0.00000	0.01881	0.00000	0.04349	0.00000	0.00027	0.00000	0.00028
16	0.00000	0.00000	0.00040	0.00000	0.00226	0.00044	0.00008	0.00024	0.00008
17	0.00000	0.00000	0.00010	0.00000	0.00178	0.00032	0.00000	0.00007	0.00015
18	0.00000	0.00000	0.00293	0.00000	0.01080	0.01157	0.00708	0.00398	0.00361
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00217	0.00019	0.00031	0.00065
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00037	0.00000
22	0.00193	0.00163	0.00848	0.00045	0.01112	0.00400	0.01623	0.00056	0.00094
23	0.00538	0.00190	0.01162	0.00045	0.01485	0.04717	0.00415	0.00090	0.00143
24	0.00671	0.00000	0.00045	0.00000	0.00080	0.00173	0.00034	0.00079	0.00032
25	0.26991	0.02255	0.05574	0.07469	0.01143	0.03795	0.03356	0.02657	0.01919
26	0.12329	0.00000	0.15703	0.00000	0.00123	0.00000	0.00552	0.00000	0.00920
27	0.00160	0.00137	0.00023	0.02439	0.00205	0.00000	0.00046	0.00000	0.00000
28	0.00894	0.00000	0.00093	0.00000	0.00080	0.00227	0.00162	0.00046	0.00119
29	0.00103	0.00322	0.00020	0.00045	0.00016	0.00032	0.00071	0.00040	0.00037
30	0.00219	0.00080	0.03402	0.00000	0.07627	0.03893	0.00498	0.00095	0.00607
31	0.00000	0.00000	0.00002	0.04171	0.12016	0.00000	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00005	0.00000	0.01565	0.00000	0.00000	0.00005	0.00000
33	0.00060	0.00000	0.00269	0.00000	0.00000	0.05926	0.00076	0.00006	0.00027
34	0.00432	0.00163	0.00185	0.00320	0.00032	0.01587	0.10996	0.00731	0.00233
35	0.00134	0.00026	0.00684	0.00000	0.00082	0.00335	0.00703	0.22018	0.00803
36	0.01462	0.00136	0.00072	0.00000	0.00388	0.00226	0.00264	0.02832	0.37387
37	0.05040	0.00517	0.00000	0.00000	0.00000	0.00000	0.00013	0.00040	0.00000
38	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00008	0.00126	0.00000
39	0.00017	0.00000	0.00541	0.00000	0.00643	0.00251	0.00028	0.00604	0.00142
40	0.00299	0.00082	0.00784	0.00000	0.01451	0.00054	0.01019	0.01014	0.00574
41	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00022	0.00013	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00201	0.00000	0.00000
44	0.00000	0.00000	0.00008	0.00000	0.00113	0.00000	0.00016	0.00080	0.00047
45	0.00000	0.00000	0.00080	0.00000	0.00000	0.00068	0.00006	0.00178	0.00178
46	0.00000	0.00000	0.00293	0.00000	0.00571	0.00874	0.00030	0.00120	0.00000
47	0.00000	0.00081	0.00064	0.00000	0.00000	0.00086	0.00090	0.01858	0.00587
48	0.00015	0.00000	0.00187	0.00045	0.00127	0.00320	0.00150	0.00483	0.00239
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00070	0.00000
50	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00005	0.00000
51	0.00000	0.00000	0.00000	0.00000	0.00000	0.00076	0.00091	0.00773	0.00298
52	0.00000	0.00000	0.00000	0.00000	0.00093	0.00019	0.00000	0.00000	0.00000
53	0.00000	0.00000	0.00069	0.00000	0.00000	0.00054	0.00133	0.00237	0.00059
54	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00004	0.00002	0.00002
55	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00000
57	0.00000	0.00000	0.00061	0.00000	0.00000	0.00000	0.00017	0.00000	0.00000
58	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00057	0.00000
60	0.00028	0.00028	0.00088	0.00000	0.00000	0.00183	0.00035	0.00138	0.00018
61	0.00014	0.00000	0.00011	0.00000	0.00016	0.00011	0.00016	0.00012	0.00005
62	0.00120	0.00000	0.00076	0.00046	0.01078	0.00085	0.00124	0.00041	0.00022
63	0.02764	0.03382	0.02436	0.01887	0.01674	0.03657	0.07251	0.04722	0.01847
64	0.00452	0.00107	0.00293	0.00090	0.00394	0.00275	0.00301	0.00194	0.00156
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00030	0.00082	0.00002	0.00046	0.00032	0.00269	0.00204	0.00213	0.00158
67	0.02093	0.00378	0.01552	0.02920	0.03094	0.02303	0.01672	0.02643	0.02421
68	0.00382	0.00295	0.00408	0.00406	0.00587	0.00544	0.00648	0.00447	0.00445
69	0.02443	0.00503	0.00833	0.00536	0.01445	0.01350	0.01249	0.00174	0.00416
70	0.00702	0.00026	0.00426	0.00044	0.00201	0.00156	0.00172	0.00228	0.00109
71	0.02662	0.01112	0.02307	0.05274	0.03315	0.02446	0.02053	0.01628	0.01440
72	0.00656	0.00106	0.00360	0.00178	0.00471	0.00390	0.00438	0.00261	0.00152
73	0.00175	0.00026	0.00129	0.00447	0.00141	0.00411	0.00415	0.00097	0.00106
74	0.00016	0.00000	0.00005	0.00000	0.00016	0.00021	0.00007	0.00009	0.00002
75	0.00107	0.00027	0.00188	0.00045	0.00195	0.00154	0.00107	0.00107	0.00074
76	0.00131	0.00026	0.00063	0.00089	0.00393	0.00095	0.00085	0.00066	0.00039
77	0.00000	0.00028	0.00005	0.00000	0.00000	0.00011	0.00019	0.00124	0.00028
78	0.02879	0.33206	0.00539	0.01238	0.00435	0.00876	0.01970	0.01071	0.01005
79	0.00268	0.17092	0.00020	0.00367	0.00258	0.02109	0.01617	0.01671	0.01239
80	0.00000	0.00041	0.00039	0.00137	0.00016	0.00042	0.01102	0.03949	0.00074
81	0.00328	0.00869	0.00027	0.00501	0.00354	0.02953	0.02262	0.02339	0.01735
TI	0.69896	0.62660	0.44122	0.65193	0.52673	0.45204	0.54523	0.61585	0.64629
VA	0.30104	0.37340	0.55878	0.34807	0.47327	0.54796	0.45477	0.38415	0.35371
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS5	37	38	39	40	41	42	43	44	45
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00005	0.00000	0.00000
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00043	0.00053	0.00030	0.00023	0.00009	0.00017	0.00005	0.00000	0.00000
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00153	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00005	0.00000	0.00041	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00161	0.00155	0.00256	0.00261	0.00140	0.00177	0.00383	0.00154	0.00294
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00000	0.00024	0.00020	0.00020	0.00019	0.00178	0.00021	0.00019	0.00045
13	0.00000	0.00006	0.00000	0.00003	0.00000	0.00008	0.00005	0.00000	0.00007
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	0.00000	0.00000	0.00000	0.00045	0.00000	0.00000	0.00000	0.00000	0.00000
16	0.00010	0.00026	0.00030	0.00030	0.00018	0.00025	0.00016	0.00000	0.00037
17	0.00032	0.00017	0.00084	0.00013	0.00000	0.00000	0.00000	0.00000	0.00000
18	0.00139	0.00211	0.00192	0.00634	0.00000	0.00253	0.00216	0.00154	0.00103
19	0.00000	0.00022	0.00108	0.00019	0.00000	0.00067	0.00033	0.00038	0.00045
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00040	0.00000
22	0.00182	0.00159	0.00340	0.00030	0.00047	0.00024	0.00026	0.00039	0.00043
23	0.00625	0.00381	0.00445	0.00787	0.00252	0.00235	0.00000	0.00039	0.00073
24	0.03731	0.00027	0.00030	0.00032	0.00028	0.00051	0.00044	0.00038	0.00052
25	0.00289	0.00189	0.00562	0.01745	0.00093	0.00017	0.00091	0.00019	0.00272
26	0.00184	0.00000	0.00123	0.00123	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00091	0.00068	0.00068	0.00046	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.01683	0.00644	0.00152	0.00727	0.00039	0.00304	0.00157	0.00039	0.00059
29	0.00011	0.00020	0.00020	0.00023	0.00019	0.00025	0.00022	0.00019	0.00058
30	0.00073	0.00369	0.00584	0.01905	0.00321	0.02980	0.01450	0.01657	0.00309
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
33	0.00000	0.00389	0.00054	0.00082	0.00000	0.00000	0.00000	0.00000	0.00007
34	0.00118	0.00263	0.00207	0.00457	0.00784	0.00268	0.00716	0.00154	0.00762
35	0.34793	0.21787	0.22739	0.11072	0.12652	0.15482	0.14816	0.14050	0.09641
36	0.08309	0.05517	0.03663	0.05702	0.04978	0.00791	0.00602	0.01885	0.02635
37	0.00121	0.00000	0.00128	0.00027	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.00000	0.01402	0.00000	0.00023	0.01842	0.00000	0.00512	0.00667	0.00574
39	0.00046	0.01537	0.02181	0.01270	0.01890	0.02272	0.00940	0.00791	0.00604
40	0.00932	0.02545	0.00957	0.02647	0.00991	0.01103	0.00971	0.01116	0.00522
41	0.00000	0.00003	0.00000	0.00158	0.09304	0.06496	0.03155	0.01294	0.00000
42	0.00000	0.00000	0.00019	0.00013	0.00047	0.03604	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.06309	0.00000	0.00000
44	0.00000	0.00000	0.00039	0.00000	0.00000	0.00000	0.00000	0.03313	0.00000
45	0.00129	0.00135	0.00283	0.00160	0.00234	0.00209	0.00265	0.00166	0.01421
46	0.00000	0.00000	0.00015	0.00033	0.00000	0.00000	0.00000	0.00000	0.00000
47	0.00148	0.00531	0.00068	0.00174	0.01889	0.06302	0.04912	0.05215	0.02459
48	0.00222	0.00527	0.01278	0.00647	0.03438	0.01509	0.01561	0.00891	0.02242
49	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
50	0.00000	0.00099	0.00000	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000
51	0.00000	0.00684	0.00083	0.00263	0.00626	0.00624	0.00965	0.02732	0.02290
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
53	0.00000	0.00025	0.00044	0.00005	0.00000	0.00099	0.00000	0.00000	0.00089
54	0.00000	0.00003	0.00000	0.00003	0.00000	0.00000	0.00005	0.00000	0.00007
55	0.00000	0.00000	0.00000	0.00016	0.00000	0.00000	0.00000	0.00000	0.00000
56	0.00000	0.00015	0.00015	0.00000	0.00814	0.00554	0.00090	0.00135	0.00000
57	0.00000	0.00030	0.00139	0.00004	0.00348	0.01489	0.00792	0.00000	0.00000
58	0.00000	0.00000	0.00025	0.00000	0.00000	0.00000	0.00011	0.00000	0.00000
59	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
60	0.00011	0.00236	0.00028	0.00046	0.00018	0.00035	0.00028	0.00056	0.00176
61	0.00011	0.00019	0.00011	0.00007	0.00009	0.00009	0.00005	0.00019	0.00014
62	0.00000	0.00049	0.00010	0.00051	0.00010	0.00076	0.00049	0.00020	0.00029
63	0.03730	0.01914	0.01304	0.01592	0.00991	0.01914	0.00925	0.01358	0.00640
64	0.00136	0.00300	0.00183	0.00246	0.00193	0.00313	0.00448	0.00301	0.00438
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00054	0.00043	0.00054	0.00065	0.00047	0.00042	0.00043	0.00058	0.00059
67	0.02027	0.02049	0.01585	0.01590	0.02663	0.03083	0.02521	0.02069	0.01775
68	0.00443	0.00374	0.00427	0.00538	0.00341	0.00563	0.00510	0.00361	0.00478
69	0.00868	0.01153	0.00644	0.00886	0.00274	0.00238	0.00594	0.01220	0.00737
70	0.00277	0.00362	0.00156	0.00217	0.00126	0.00210	0.00124	0.00110	0.00133
71	0.02582	0.01543	0.01284	0.01833	0.01195	0.02413	0.02024	0.00788	0.01847
72	0.00241	0.00448	0.00187	0.00296	0.00295	0.00437	0.00358	0.00544	0.00709
73	0.00115	0.00197	0.00082	0.00169	0.00337	0.00115	0.00205	0.00450	0.00100
74	0.00000	0.00007	0.00005	0.00007	0.00000	0.00009	0.00038	0.00019	0.00030
75	0.00094	0.00128	0.00168	0.00128	0.00074	0.00094	0.00087	0.00114	0.00141
76	0.00020	0.00067	0.00048	0.00073	0.00064	0.00123	0.00079	0.00112	0.00150
77	0.00000	0.00003	0.00005	0.00006	0.00010	0.00008	0.00000	0.00000	0.00000
78	0.00289	0.00535	0.00533	0.00618	0.00505	0.00682	0.00582	0.00519	0.01586
79	0.00418	0.00334	0.00424	0.00510	0.00365	0.00328	0.03343	0.00443	0.00455
80	0.00000	0.00102	0.00039	0.00019	0.00028	0.00050	0.00038	0.00019	0.00022
81	0.00589	0.00466	0.00591	0.00712	0.00514	0.00463	0.00469	0.00616	0.00638
TI	0.63975	0.48362	0.42750	0.38882	0.48880	0.56366	0.51566	0.43859	0.34807
VA	0.36025	0.51638	0.57250	0.61118	0.51120	0.43634	0.48434	0.56141	0.65193
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS6	46	47	48	49	50	51	52	53	54
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	0.00007	0.00000	0.00006	0.00000	0.00000	0.00010
3	0.00000	0.00000	0.00000	0.00008	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00000	0.00006	0.00012	0.00007	0.00008	0.00013	0.00000	0.00012	0.00007
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00070	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00237	0.00219	0.00170	0.00194	0.00103	0.00255	0.00193	0.00141	0.00192
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00044	0.00035	0.00025	0.00120	0.00016	0.00058	0.00036	0.00047	0.00066
13	0.00010	0.00006	0.00012	0.00017	0.00008	0.00013	0.00009	0.00012	0.00009
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00344	0.00232	0.00000
15	0.00000	0.00284	0.00157	0.00000	0.00000	0.00013	0.00138	0.00000	0.00000
16	0.00022	0.00024	0.00098	0.00015	0.00016	0.00038	0.00009	0.00024	0.00033
17	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00035	0.00000
18	0.00529	0.00262	0.00072	0.00030	0.00167	0.00242	0.00368	0.00223	0.00086
19	0.00033	0.00053	0.00012	0.00000	0.00095	0.00076	0.00110	0.00000	0.00065
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01203
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00020	0.00000	0.00000	0.00000
22	0.00043	0.00184	0.00049	0.00343	0.00103	0.00454	0.00120	0.00036	0.00214
23	0.00109	0.00274	0.00739	0.00398	0.00801	0.00459	0.01583	0.01426	0.00266
24	0.00053	0.00035	0.00061	0.00291	0.00024	0.00076	0.00065	0.00035	0.00470
25	0.02632	0.00012	0.00447	0.00225	0.00474	0.00817	0.00827	0.01175	0.00093
26	0.00000	0.00061	0.00000	0.00123	0.00184	0.00675	0.01165	0.01227	0.00491
27	0.00000	0.00000	0.00023	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00075	0.00013	0.00062	0.00142	0.00198	0.00307	0.00853	0.00247	0.00046
29	0.00064	0.00058	0.00096	0.00015	0.00032	0.00045	0.00009	0.00012	0.00010
30	0.01172	0.00702	0.00521	0.02204	0.01363	0.01236	0.03728	0.02151	0.00736
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00010	0.00000	0.00000	0.00010	0.00000	0.00005	0.00000	0.00000	0.00005
33	0.00108	0.00000	0.00000	0.00015	0.00055	0.00051	0.00330	0.02018	0.00175
34	0.00280	0.00497	0.00665	0.00082	0.00332	0.00981	0.00880	0.00316	0.00069
35	0.10816	0.13381	0.10381	0.01837	0.09485	0.07696	0.09157	0.05469	0.00982
36	0.03649	0.02818	0.04663	0.02030	0.04793	0.07530	0.04720	0.05583	0.02601
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
38	0.01227	0.00651	0.00000	0.00524	0.00455	0.00663	0.00000	0.00000	0.00101
39	0.00615	0.00996	0.01321	0.01964	0.01788	0.01594	0.02437	0.02329	0.01480
40	0.01651	0.00943	0.01792	0.01425	0.02250	0.00900	0.02765	0.01047	0.01007
41	0.01372	0.00612	0.00196	0.00000	0.00357	0.00353	0.00000	0.00000	0.00000
42	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00028	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
44	0.00055	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
45	0.00406	0.00314	0.00548	0.00123	0.00074	0.00191	0.00123	0.00141	0.00105
46	0.04816	0.00000	0.00000	0.00000	0.00000	0.00000	0.00036	0.00000	0.00042
47	0.04709	0.06264	0.01097	0.00390	0.01803	0.00515	0.00733	0.00012	0.00039
48	0.01797	0.01431	0.06169	0.00448	0.00328	0.00628	0.00316	0.00231	0.00270
49	0.00032	0.00000	0.00000	0.20037	0.00000	0.00220	0.00000	0.00000	0.00114
50	0.00032	0.00000	0.00000	0.00000	0.03366	0.00000	0.00808	0.00000	0.00006
51	0.02515	0.02793	0.00629	0.02732	0.07795	0.07204	0.04015	0.01952	0.00581
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00875	0.00000	0.00019
53	0.00000	0.00000	0.00000	0.00350	0.00370	0.01110	0.01110	0.02881	0.00933
54	0.00011	0.00006	0.00000	0.00141	0.00000	0.00006	0.00009	0.00012	0.05981
55	0.00128	0.00125	0.00000	0.09157	0.00000	0.01882	0.00000	0.00225	0.12422
56	0.00000	0.00005	0.00364	0.00000	0.00025	0.00000	0.00230	0.01667	0.00060
57	0.00030	0.00000	0.00157	0.00009	0.00000	0.00000	0.00000	0.00000	0.00004
58	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00003
59	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
60	0.00053	0.00148	0.00060	0.00201	0.01062	0.00134	0.02599	0.00025	0.00106
61	0.00021	0.00012	0.00012	0.00014	0.00007	0.00012	0.00009	0.00012	0.00016
62	0.00010	0.00012	0.00049	0.00210	0.00190	0.00102	0.00276	0.00012	0.00029
63	0.00159	0.01005	0.01686	0.01983	0.01126	0.01714	0.01297	0.01267	0.00988
64	0.00623	0.00412	0.00462	0.00737	0.00326	0.00655	0.00215	0.00356	0.00556
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00054	0.00053	0.00073	0.00045	0.00040	0.00070	0.00046	0.00047	0.00036
67	0.02223	0.02349	0.01530	0.03164	0.02506	0.02064	0.02742	0.02059	0.01842
68	0.00585	0.00462	0.00572	0.01095	0.00344	0.00522	0.00361	0.00359	0.00507
69	0.02358	0.00833	0.01819	0.05554	0.00749	0.01481	0.01352	0.01055	0.01440
70	0.00197	0.00108	0.00268	0.00846	0.00236	0.01679	0.00229	0.00349	0.01202
71	0.01768	0.01752	0.01725	0.03348	0.01993	0.02825	0.03376	0.01846	0.03528
72	0.00705	0.00584	0.00643	0.02358	0.00325	0.00865	0.00340	0.00448	0.01189
73	0.00158	0.00191	0.00177	0.00284	0.00270	0.00186	0.00054	0.00298	0.00254
74	0.00010	0.00035	0.00012	0.00089	0.00009	0.00002	0.00019	0.00012	0.00049
75	0.00141	0.00128	0.00154	0.00208	0.00074	0.00168	0.00128	0.00168	0.00195
76	0.00158	0.00116	0.00095	0.00145	0.00061	0.00112	0.00152	0.00069	0.00193
77	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00003
78	0.01748	0.03937	0.02616	0.00310	0.00880	0.01206	0.00248	0.00317	0.00267
79	0.00421	0.01601	0.00569	0.00270	0.00318	0.00548	0.00358	0.00364	0.00283
80	0.00011	0.00018	0.00121	0.00017	0.00049	0.00057	0.00037	0.00035	0.00003
81	0.00593	0.00581	0.00799	0.00379	0.00448	0.00766	0.00505	0.00505	0.00395
TI	0.51276	0.47402	0.43978	0.66683	0.47950	0.51499	0.52475	0.40521	0.44075
VA	0.48724	0.52598	0.56022	0.33317	0.52050	0.48501	0.47525	0.59479	0.55925
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS7	55	56	57	58	59	60	61	62	63
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00007
2	0.00006	0.00000	0.00001	0.00012	0.00006	0.00012	0.00000	0.00201	0.00018
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00011	0.00004
4	0.00013	0.00000	0.00003	0.00013	0.00013	0.00006	0.00008	0.00005	0.00000
5	0.00000	0.00043	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00054	0.00000	0.00000	0.00000	0.00005	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00011	0.00011	0.00000	0.00173	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00223	0.00163	0.00119	0.00305	0.00176	0.00159	0.00493	0.00261	0.02912
11	0.00000	0.00000	0.00000	0.00011	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00058	0.00022	0.00008	0.00129	0.00038	0.00248	0.00033	0.00258	0.00310
13	0.00013	0.00011	0.00002	0.00026	0.00008	0.00017	0.00008	0.00010	0.00006
14	0.00000	0.00000	0.00024	0.00073	0.00040	0.00568	0.00000	0.01120	0.00008
15	0.00000	0.00022	0.00177	0.00026	0.01006	0.00382	0.00024	0.00384	0.00058
16	0.00038	0.00055	0.00014	0.00029	0.00094	0.00053	0.00016	0.00052	0.00045
17	0.00000	0.00000	0.00879	0.00000	0.00189	0.00000	0.00000	0.00179	0.00056
18	0.00000	0.00152	0.00118	0.00026	0.05302	0.00375	0.00033	0.03218	0.00013
19	0.00000	0.00000	0.00019	0.00032	0.00000	0.00000	0.00000	0.00057	0.00000
20	0.00064	0.00000	0.00000	0.00000	0.00704	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00204	0.00109	0.00329	0.00000	0.00000	0.00000	0.00000
22	0.00261	0.00054	0.00056	0.00067	0.00139	0.00640	0.02458	0.01495	0.00141
23	0.00420	0.00459	0.00101	0.00061	0.00014	0.00501	0.00664	0.02140	0.00053
24	0.00051	0.00108	0.00024	0.00222	0.00063	0.00106	0.00048	0.00087	0.00204
25	0.01921	0.02527	0.00174	0.00093	0.00150	0.00118	0.06122	0.00824	0.00154
26	0.00736	0.00920	0.00123	0.00307	0.00613	0.00797	0.00307	0.03190	0.00000
27	0.00000	0.00000	0.00000	0.00000	0.00023	0.00068	0.00000	0.00046	0.00023
28	0.00005	0.00021	0.00245	0.00164	0.00990	0.00082	0.00000	0.00513	0.00031
29	0.00019	0.00011	0.00011	0.00029	0.00038	0.00029	0.00024	0.00050	0.00366
30	0.02228	0.02355	0.02119	0.00185	0.01459	0.01741	0.02102	0.04068	0.00684
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00107	0.00000
32	0.00000	0.00000	0.00000	0.00008	0.00000	0.00024	0.00000	0.00159	0.00000
33	0.01422	0.00022	0.00709	0.00010	0.00547	0.00369	0.00363	0.00056	0.00020
34	0.00559	0.00315	0.00294	0.00080	0.00616	0.00194	0.00032	0.00614	0.00029
35	0.01223	0.02275	0.06700	0.02617	0.14210	0.01811	0.02093	0.03227	0.00402
36	0.04289	0.11732	0.01167	0.03705	0.03646	0.03889	0.04057	0.06733	0.00043
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00114	0.00000	0.00000	0.00000
38	0.00000	0.00000	0.00012	0.00000	0.04795	0.00285	0.00008	0.00000	0.00000
39	0.01833	0.00467	0.05768	0.00770	0.00905	0.01708	0.00621	0.00752	0.00040
40	0.01521	0.01602	0.02083	0.01085	0.02392	0.01392	0.00614	0.01332	0.00256
41	0.00000	0.00000	0.00776	0.00068	0.04512	0.00000	0.00000	0.00006	0.00192
42	0.00000	0.00000	0.00004	0.00000	0.00057	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00507	0.00000	0.00000	0.00000	0.00000
44	0.00000	0.00000	0.00005	0.00000	0.00227	0.00000	0.00000	0.00020	0.00005
45	0.00917	0.00160	0.00068	0.00236	0.00117	0.00105	0.00000	0.00012	0.00006
46	0.00000	0.00000	0.00000	0.00000	0.00143	0.00000	0.00000	0.00010	0.00000
47	0.00025	0.01149	0.00321	0.00658	0.03212	0.00127	0.00318	0.00126	0.00253
48	0.00307	0.00161	0.00855	0.01993	0.00546	0.00556	0.00160	0.00181	0.00056
49	0.00032	0.00000	0.00001	0.00187	0.00013	0.00029	0.00000	0.00000	0.00002
50	0.00000	0.00000	0.00250	0.00000	0.01176	0.00000	0.00000	0.00021	0.00005
51	0.00293	0.00513	0.00081	0.00124	0.01560	0.01427	0.00258	0.00318	0.00096
52	0.00000	0.00000	0.00000	0.00000	0.01098	0.00000	0.00000	0.00000	0.00000
53	0.00109	0.00543	0.00336	0.00004	0.00405	0.00380	0.00138	0.00104	0.00025
54	0.00006	0.00000	0.00255	0.03665	0.00745	0.00006	0.00008	0.00056	0.00024
55	0.10508	0.00762	0.00056	0.01827	0.00037	0.01264	0.01770	0.00293	0.00050
56	0.00050	0.03050	0.01108	0.00267	0.00130	0.00225	0.00010	0.00030	0.00110
57	0.00000	0.00013	0.13242	0.00000	0.01541	0.00017	0.00009	0.00004	0.00353
58	0.00000	0.00000	0.00002	0.15595	0.00000	0.00000	0.00000	0.00000	0.00624
59	0.00000	0.00000	0.00022	0.00000	0.05861	0.00000	0.00000	0.00042	0.00972
60	0.00120	0.00042	0.00123	0.00739	0.00515	0.03495	0.00130	0.00088	0.00053
61	0.00012	0.00011	0.00009	0.00209	0.00025	0.00088	0.02570	0.00016	0.00009
62	0.00012	0.00010	0.00015	0.00033	0.00163	0.00259	0.00322	0.03099	0.00039
63	0.01266	0.01292	0.01207	0.01372	0.01844	0.01347	0.01236	0.02188	0.12469
64	0.00467	0.00277	0.00091	0.00458	0.00327	0.00506	0.00434	0.00491	0.01308
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00057	0.00044	0.00025	0.00045	0.00044	0.00035	0.00032	0.00046	0.00057
67	0.01678	0.01475	0.03018	0.01307	0.04009	0.01783	0.02090	0.03017	0.02076
68	0.00689	0.00826	0.00226	0.00433	0.00589	0.00469	0.00987	0.00999	0.02205
69	0.01148	0.01487	0.00117	0.00576	0.00706	0.00951	0.00780	0.01633	0.01902
70	0.00855	0.00575	0.00106	0.00907	0.00236	0.00463	0.00473	0.00507	0.00166
71	0.02668	0.02581	0.01278	0.03175	0.02222	0.03178	0.03939	0.04594	0.04042
72	0.01012	0.00430	0.00133	0.02426	0.00607	0.00761	0.00567	0.00653	0.00842
73	0.00273	0.00488	0.00588	0.00163	0.00098	0.00292	0.00197	0.00210	0.02274
74	0.00019	0.00010	0.00005	0.00054	0.00012	0.00042	0.00031	0.00010	0.00040
75	0.00221	0.00208	0.00047	0.00179	0.00148	0.00195	0.00524	0.00443	0.00161
76	0.00112	0.00053	0.00061	0.00175	0.00110	0.00143	0.00087	0.00195	0.00133
77	0.00006	0.00000	0.00002	0.00004	0.00000	0.00012	0.00008	0.00067	0.00181
78	0.00515	0.00010	0.00293	0.00780	0.01385	0.02242	0.00654	0.01383	0.09109
79	0.00445	0.00338	0.00195	0.00350	0.00470	0.00781	0.00250	0.00358	0.00488
80	0.00006	0.00022	0.00067	0.00019	0.00051	0.00017	0.00169	0.00015	0.00003
81	0.00623	0.02625	0.00273	0.00491	0.00658	0.01096	0.00347	0.00502	0.00626
TI	0.41353	0.42544	0.46414	0.48713	0.74624	0.37993	0.38626	0.53057	0.46836
VA	0.58647	0.57456	0.53586	0.51287	0.25376	0.62007	0.61374	0.46943	0.53164
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS8	64	65	66	67	68	69	70	71	72
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00639
2	0.00002	0.00000	0.00021	0.00008	0.00012	0.00129	0.00093	0.00014	0.01494
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00668
4	0.00426	0.00015	0.00166	0.00057	0.00004	0.00494	0.00084	0.00008	0.00000
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.03402	0.00405	0.03170	0.00406	0.00473	0.07876	0.01375	0.00729	0.00383
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00033	0.00000
12	0.00032	0.00015	0.00021	0.00069	0.00107	0.00011	0.00261	0.00089	0.39487
13	0.00004	0.00000	0.00000	0.00008	0.00021	0.00002	0.00068	0.00018	0.00000
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00272	0.00000	0.00000
15	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00050	0.00021	0.00000
16	0.00044	0.00000	0.00021	0.00014	0.00000	0.00001	0.01032	0.00050	0.00000
17	0.00000	0.00000	0.00000	0.00035	0.00049	0.00000	0.00549	0.00009	0.00040
18	0.00000	0.00000	0.00000	0.00019	0.00000	0.00000	0.00129	0.00064	0.00000
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00141	0.00061	0.00062	0.00538	0.00679	0.00028	0.00824	0.00572	0.00489
23	0.00000	0.00000	0.00000	0.00202	0.00000	0.00000	0.00289	0.00096	0.00715
24	0.00473	0.00106	0.00124	0.00203	0.02043	0.00042	0.00371	0.01313	0.00107
25	0.00007	0.00000	0.00311	0.00010	0.00010	0.00076	0.00721	0.00734	0.00055
26	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00000	0.00000	0.00000	0.00046	0.00000	0.00000	0.01117	0.00304	0.00271
28	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00046	0.00047	0.00000
29	0.00005	0.00015	0.00225	0.00071	0.00026	0.00031	0.00112	0.00084	0.00002
30	0.00035	0.00059	0.00061	0.00244	0.00067	0.00183	0.01157	0.00790	0.00372
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00000	0.00000	0.00000	0.00005	0.00010	0.00000	0.00295	0.00017	0.00000
33	0.00002	0.00000	0.00000	0.00030	0.00004	0.00000	0.00054	0.00080	0.00098
34	0.00000	0.00000	0.00000	0.00005	0.00002	0.00000	0.00331	0.00092	0.00104
35	0.00004	0.00000	0.00022	0.00004	0.00000	0.00000	0.00030	0.00057	0.00000
36	0.00087	0.00000	0.00020	0.00000	0.00000	0.00000	0.00026	0.00000	0.00032
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00024	0.00000
38	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00000	0.00000	0.00000
39	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00194	0.00284	0.00108
40	0.00000	0.00000	0.00021	0.00031	0.00002	0.00000	0.00631	0.00463	0.00007
41	0.00000	0.00000	0.00249	0.00000	0.00000	0.00000	0.00215	0.00257	0.00000
42	0.00000	0.00000	0.00000	0.00004	0.00000	0.00015	0.00000	0.00355	0.00000
43	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
44	0.00000	0.00000	0.00000	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000
45	0.00000	0.00000	0.00000	0.00006	0.00000	0.00000	0.00000	0.00009	0.00000
46	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00035	0.00045
47	0.00000	0.00000	0.00061	0.00001	0.00002	0.00002	0.00040	0.00154	0.00000
48	0.00000	0.00000	0.00000	0.00028	0.00000	0.00001	0.00171	0.00307	0.00009
49	0.00016	0.00000	0.00021	0.00008	0.00049	0.00000	0.00406	0.00311	0.00000
50	0.00000	0.00000	0.00000	0.00027	0.00000	0.00000	0.00186	0.00039	0.00000
51	0.00000	0.00000	0.00040	0.00000	0.00000	0.00000	0.00162	0.00466	0.00000
52	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00465	0.00026	0.00000
53	0.00069	0.00014	0.00123	0.00010	0.00015	0.00005	0.00035	0.00003	0.00012
54	0.02599	0.00209	0.00000	0.00002	0.00012	0.00001	0.00005	0.00010	0.00000
55	0.00144	0.00691	0.00000	0.00003	0.00016	0.00000	0.00865	0.00342	0.00000
56	0.00015	0.00000	0.00000	0.00015	0.00010	0.00005	0.00025	0.00021	0.00000
57	0.00004	0.00000	0.00022	0.00026	0.00013	0.00004	0.00039	0.00028	0.00000
58	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
59	0.00047	0.00061	0.00000	0.00005	0.00020	0.00002	0.00121	0.00192	0.00000
60	0.00000	0.00000	0.00000	0.00004	0.00004	0.00000	0.00243	0.00012	0.00000
61	0.00021	0.00151	0.00021	0.00012	0.00037	0.00005	0.00504	0.00598	0.00000
62	0.00044	0.00014	0.00020	0.00032	0.00081	0.00010	0.01203	0.00372	0.00091
63	0.00391	0.01044	0.00792	0.01262	0.00524	0.00178	0.00822	0.02986	0.01512
64	0.01879	0.03095	0.00365	0.01533	0.03001	0.00218	0.01575	0.03074	0.00330
65	0.00000	0.00084	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00063	0.00104	0.01361	0.00109	0.00077	0.00046	0.00171	0.00057	0.00114
67	0.00226	0.00268	0.00598	0.01178	0.00498	0.00293	0.02097	0.01322	0.05169
68	0.01088	0.01285	0.00735	0.01277	0.19451	0.02096	0.01642	0.01637	0.00976
69	0.02908	0.07486	0.00929	0.04429	0.04476	0.08040	0.08231	0.07320	0.04648
70	0.00641	0.01051	0.00438	0.00465	0.00500	0.00150	0.03645	0.01644	0.01223
71	0.04303	0.07603	0.01334	0.06003	0.10262	0.01872	0.06070	0.12044	0.02929
72	0.00574	0.00483	0.00202	0.01329	0.02415	0.00250	0.00727	0.01796	0.00000
73	0.00459	0.00175	0.00243	0.01455	0.00550	0.00250	0.01489	0.01983	0.00049
74	0.00063	0.25390	0.00021	0.00019	0.00052	0.00007	0.00014	0.00495	0.00885
75	0.00168	0.00242	0.00040	0.00235	0.00852	0.00034	0.00228	0.00433	0.00367
76	0.00526	0.00117	0.00222	0.00423	0.02058	0.00304	0.00231	0.01159	0.00118
77	0.00084	0.00180	0.00020	0.00099	0.00053	0.00054	0.00172	0.00060	0.00090
78	0.00122	0.00405	0.14712	0.01955	0.00696	0.00849	0.03053	0.02295	0.00035
79	0.00494	0.00825	0.15085	0.00855	0.00602	0.00359	0.01341	0.00442	0.00898
80	0.00000	0.00000	0.09179	0.00000	0.00000	0.00002	0.00065	0.00000	0.00000
81	0.00691	0.01154	0.14939	0.01197	0.00843	0.00503	0.01877	0.00618	0.01257
TI	0.22301	0.52803	0.66016	0.26023	0.50677	0.24436	0.48245	0.48893	0.65829
VA	0.77699	0.47197	0.33984	0.73977	0.49323	0.75564	0.51755	0.51107	0.34171
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE XLIX (Continued)

ARUS9	73	74	75	76	77	78	79	80	81
1	0.00000	0.00368	0.00131	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00003	0.04668	0.00077	0.00802	0.00047	0.00001	0.00013	0.00000	0.00017
3	0.00000	0.00000	0.00008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00000	0.00724	0.00112	0.00000	0.00119	0.00000	0.00103	0.00000	0.00166
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00023	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00001	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00076	0.00001	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00065	0.00038	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00695	0.01594	0.01884	0.01259	0.20421	0.01243	0.02765	0.00572	0.03165
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00018	0.00308	0.02093	0.00150	0.00028	0.00058	0.00015	0.00000	0.00021
13	0.00003	0.00024	0.00012	0.00006	0.00009	0.00001	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00008	0.00020	0.00000	0.00000	0.00000	0.00136	0.00000
15	0.00000	0.00071	0.00002	0.00018	0.00010	0.00000	0.00000	0.00000	0.00000
16	0.00178	0.00020	0.00206	0.00000	0.00201	0.00001	0.00015	0.00029	0.00019
17	0.00000	0.00057	0.00210	0.00143	0.00014	0.00000	0.00000	0.00000	0.00000
18	0.00000	0.00000	0.00021	0.00000	0.00000	0.00004	0.00000	0.00525	0.00000
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00212	0.00114	0.00321	0.00232	0.00186	0.00114	0.00040	0.00206	0.00062
23	0.00000	0.00000	0.00095	0.00037	0.00000	0.00130	0.00000	0.00000	0.00000
24	0.00020	0.00459	0.01123	0.00531	0.00425	0.00005	0.00080	0.00006	0.00125
25	0.00017	0.00289	0.00883	0.00125	0.03462	0.01669	0.00341	0.01004	0.00310
26	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000
27	0.00000	0.00023	0.01709	0.00372	0.00274	0.00093	0.00000	0.00000	0.00000
28	0.00570	0.00000	0.00013	0.00006	0.00005	0.00006	0.00003	0.00000	0.00000
29	0.00083	0.00024	0.00055	0.00048	0.00189	0.00228	0.00148	0.00012	0.00228
30	0.01759	0.00083	0.00778	0.00262	0.00098	0.00058	0.00041	0.00614	0.00062
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
32	0.00003	0.00198	0.00010	0.00020	0.00000	0.00002	0.00000	0.00000	0.00000
33	0.00499	0.00005	0.00115	0.00018	0.00033	0.00006	0.00003	0.00000	0.00000
34	0.01070	0.00000	0.00022	0.00006	0.00067	0.00115	0.00005	0.00372	0.00000
35	0.00000	0.00000	0.00015	0.00006	0.00052	0.00117	0.00136	0.00874	0.00019
36	0.00000	0.00000	0.00000	0.00024	0.00000	0.00093	0.00013	0.00195	0.00019
37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00355	0.00000	0.00000	0.00000
38	0.00000	0.00000	0.00000	0.00006	0.00005	0.00014	0.00018	0.00000	0.00000
39	0.01610	0.00000	0.00046	0.00102	0.00040	0.00000	0.00000	0.00909	0.00000
40	0.00991	0.00009	0.00059	0.00024	0.00114	0.00116	0.00088	0.00283	0.00021
41	0.00283	0.00000	0.00000	0.00036	0.00211	0.00039	0.00205	0.00142	0.00247
42	0.00000	0.00000	0.00000	0.00000	0.00034	0.00000	0.00000	0.00000	0.00000
43	0.00000	0.00000	0.00000	0.00006	0.00175	0.00106	0.00055	0.04393	0.00000
44	0.00000	0.00000	0.00000	0.00006	0.00000	0.00001	0.00000	0.00213	0.00000
45	0.00004	0.00000	0.00000	0.00000	0.00006	0.00000	0.00003	0.00017	0.00000
46	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
47	0.00054	0.00024	0.00006	0.00012	0.00029	0.00115	0.00111	0.00100	0.00062
48	0.00976	0.00000	0.00000	0.00000	0.00019	0.00062	0.00066	0.00053	0.00000
49	0.00000	0.00000	0.00015	0.00035	0.00000	0.00000	0.00013	0.00000	0.00021
50	0.02759	0.00043	0.00010	0.00012	0.00009	0.00000	0.00000	0.00000	0.00000
51	0.00055	0.00000	0.00000	0.00000	0.00187	0.00082	0.00128	0.00041	0.00041
52	0.00000	0.00000	0.00000	0.00030	0.00000	0.00000	0.00000	0.00000	0.00000
53	0.00470	0.00020	0.00069	0.00012	0.00113	0.00006	0.00085	0.00142	0.00125
54	0.00474	0.00014	0.00011	0.00012	0.00005	0.00003	0.00001	0.00000	0.00000
55	0.00000	0.00000	0.00025	0.00005	0.00009	0.00000	0.00000	0.00000	0.00000
56	0.00260	0.00005	0.00005	0.00012	0.00105	0.00002	0.00000	0.00006	0.00000
57	0.22774	0.00009	0.00004	0.00096	0.00257	0.00001	0.00015	0.00011	0.00021
58	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002	0.00003	0.00000	0.00000
59	0.00053	0.00077	0.00027	0.00048	0.00239	0.00000	0.00000	0.00000	0.00000
60	0.00000	0.00000	0.00959	0.00006	0.00032	0.00024	0.00000	0.00006	0.00000
61	0.00003	0.00525	0.00326	0.00042	0.00014	0.00001	0.00013	0.00000	0.00021
62	0.00012	0.00176	0.00264	0.00048	0.00034	0.00006	0.00016	0.00035	0.00021
63	0.01381	0.00691	0.01055	0.11202	0.01598	0.02443	0.00591	0.00649	0.00806
64	0.00751	0.00712	0.01050	0.00321	0.00783	0.00106	0.00271	0.00708	0.00373
65	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
66	0.00049	0.00085	0.00160	0.00178	0.00855	0.00268	0.01120	0.01925	0.01364
67	0.05615	0.01247	0.01296	0.00309	0.00939	0.00311	0.00436	0.01695	0.00599
68	0.01159	0.01454	0.01250	0.01281	0.00813	0.00272	0.00551	0.00407	0.00745
69	0.04619	0.07854	0.07013	0.02612	0.01730	0.02281	0.02987	0.03070	0.00952
70	0.00179	0.01008	0.01233	0.00527	0.00160	0.00029	0.00300	0.00053	0.00454
71	0.02726	0.06415	0.04860	0.03194	0.03581	0.01057	0.01195	0.01907	0.01366
72	0.00317	0.02191	0.01481	0.00404	0.00732	0.00139	0.00210	0.00088	0.00207
73	0.00334	0.00475	0.00407	0.00587	0.00242	0.00036	0.00178	0.00259	0.00247
74	0.00005	0.16334	0.00198	0.00090	0.00009	0.00006	0.00015	0.00000	0.00021
75	0.00076	0.00322	0.01980	0.00044	0.00094	0.00022	0.00033	0.00082	0.00040
76	0.00048	0.00189	0.00788	0.00198	0.00131	0.00025	0.00150	0.00035	0.00228
77	0.00102	0.00062	0.00078	0.00066	0.00019	0.00025	0.00020	0.00017	0.00021
78	0.02275	0.00638	0.01514	0.01289	0.05151	0.32841	0.13283	0.02609	0.13155
79	0.00386	0.00662	0.01254	0.01396	0.06697	0.15468	0.18849	0.00767	0.14527
80	0.00000	0.00000	0.00062	0.04259	0.02342	0.00056	0.05759	0.18174	0.08004
81	0.00540	0.00927	0.01756	0.01957	0.09378	0.02299	0.03639	0.00697	0.14601
TI	0.56471	0.51192	0.39163	0.34608	0.62569	0.62642	0.54130	0.44061	0.62503
VA	0.43529	0.48808	0.60837	0.65392	0.37431	0.37358	0.45870	0.55939	0.37497
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

VITA

Vorawoot Hirunruk

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE ECONOMIC IMPACTS OF ENERGY PRICE CHANGES ON THE ECONOMY OF OKLAHOMA: AN APPLICATION OF AN INTERREGIONAL INPUT-OUTPUT PRICE MODEL

Major Field: Agricultural Economics

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